EXPERT REPORT OF STEFAN BOEDEKER

IN SUPPORT OF PLAINTIFFS' MOTION FOR CLASS CERTIFICATION

November 5, 2018

REDACTED - FILED UNDER SEAL

Table of Contents

EXPERT REPORT OF STEFAN BOEDEKER

Table of Figures

EXPERT REPORT OF STEFAN BOEDEKER

1 Introduction

1.1 Qualifications

1.   I am a Statistician and Economist. I received a Bachelor of Science degree in Statistics and a Bachelor of Arts degree in Business Administration from the University of Dortmund in Germany in 1988. I received a Master of Science degree in Statistics from the University of Dortmund in Germany in 1988, and I received a Master of Arts degree in Economics from the University of California, San Diego in 1992. I also completed Ph.D. requirements (except dissertation) in Economics at the University of California, San Diego.

2.   I am a Managing Director at the Berkeley Research Group ("BRG") based at 550 South Hope Street, Suite 2150, Los Angeles, CA, 90071. Prior to joining BRG, I was a Partner at Resolution Economics. I also held Managing Director positions at Alvarez & Marsal, Navigant Consulting, and LECG. I held partner-level positions at Deloitte & Touche LLP, PricewaterhouseCoopers LLP, and Arthur Andersen LLP. At the three latter firms, I was responsible for the Economic and Statistical Consulting group on the West Coast. Before moving to the United States to attend graduate school, I worked as a statistician for the German Government from 1986 to 1989.

3.   For over 25 years, my work has focused on the application of economic, statistical, and financial models to a variety of areas, such as providing solutions to business problems, supporting complex litigation in a consulting and expert witness role, and conducting economic impact studies in a large variety of industries including, but not limited to, healthcare, retail, grocery manufacturing, technology, entertainment, manufacturing, automotive, energy and utilities, hospitality, and federal, state, and local government agencies.

4.   I have extensive experience designing and conducting surveys and conjoint studies as well as statistically analyzing results from surveys, in both the litigation context as a consultant and/or designated expert and the non-litigation context as a statistical or economic consultant. I have issued numerous expert and rebuttal reports dealing with surveys, conjoint analysis, and statistical sampling related issues. I have been deposed on numerous occasions and have also testified in court regarding surveys, conjoint studies, and statistical sampling-related issues.

EXPERT REPORT OF STEFAN BOEDEKER

5.   More specifically, several courts have accepted my use of conjoint analysis to measure economic losses associated with alleged product defects, misleading and false advertising, and products with attributes that demand a price premium.[1]

6.   I am not an expert on manufacturing or marketing smartphones. I do not have an opinion one way or the other about the allegations in this case. Instead, I have relied on my experience and expertise in designing surveys and conjoint studies and applying economic theory and statistical methodologies based on the assumptions provided herein as to the alleged misleading statements and omissions at issue in this litigation.

7.   All the facts and circumstances set forth in this report are known to me personally and I am prepared to testify to them if called upon to do so. My *curriculum vitae* which includes matters in which I have testified is attached to this report as Exhibit A. BRG is being compensated for its work on this matter based on an agreed upon hourly billing rate schedule. My hourly billing rate for professional services related to this case and testimony in deposition or trial is $725 and the billing rates of BRG staff supporting me on this engagement range from $150 to $550. BRG's payment in this matter is not contingent upon my opinions or the outcome of this litigation.

1.2 Case Background[2]

8.   It is my understanding that Plaintiffs allege that the Google Pixel and Pixel XL smartphones (collectively, the "Pixel") manufactured ▮▮▮▮▮▮▮▮▮▮▮▮ are defective. Immediately after releasing the Pixel, Google heard directly from numerous customers who were experiencing audio failures. The audio failures stem from faulty hardware. The computer chip responsible for processing the Pixel's audio functions—the "audio codec"—was ▮▮▮▮▮▮ ▮▮▮▮▮▮▮▮▮▮▮▮▮▮▮▮▮▮ (the "Defect"). As a result, ▮▮▮▮▮▮▮▮▮▮▮▮ ▮▮▮▮▮▮ lead to microphone and speaker failures. In its ▮▮▮▮▮▮▮▮ ▮▮▮▮▮▮▮▮▮▮▮▮▮▮▮ Accordingly, when the Defect manifests, the user cannot make or receive phone calls without headphones, use the Pixel's speakers, or use the Pixel's voice-activated "Google Assistant" feature.

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[1]   See for example *Broomfield v. Craft Brew Alliance, Inc.*; *In re MyFord Touch Consumer Litig.*; *Davidson v. Apple, Inc.*; *In re Dial Complete Mktg. & Sales Prac. Litig.*
[2]   Plaintiffs' counsel provided me the information used to draft this section.

EXPERT REPORT OF STEFAN BOEDEKER

9.   Google has known about the audio failures since at least the day after it released the Pixel, but nevertheless sold approximately ▆▆▆▆ defective Pixels without disclosing their defective nature to consumers. Of the ▆▆▆▆ defective Pixels that Google sold, approximately ▆▆▆ have manifested the Defect. Thus, Plaintiffs estimate the failure rate to be at least ▆▆▆.[3] Plaintiffs expect to update this figure as discovery progresses.

1.3   Assignment

10.   I was retained by counsel for Plaintiffs to:

a. Outline and develop a theory of economic losses to the members of the putative class attributable to the non-disclosed Defect, and to provide a framework for the computation of class-wide damages.

b. Outline and develop an empirical study to assess consumers' changes in choices and preferences if they were given the information at the point of purchase that the Pixel they are about to purchase has a manufacturing imperfection that could manifest after normal use of the smartphone.

c. Outline and develop a statistical methodology to quantify class-wide damages if the disclosure of the Defect at the point of purchase leads consumers to no longer purchase the product or to purchase the product at a reduced price.

1.4   Materials Considered

11.   In forming my opinions for this report, I have considered documents provided to me by Plaintiffs' counsel. All documents I reviewed and relied upon in forming my opinions are cited in the text and in the footnotes to this report.

12.   In addition, I have considered all materials cited in the text and in the footnotes to this report.

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[3]   Plaintiffs contend that the actual failure rate is likely higher because the ▆▆▆▆ number is under-inclusive. First, it has ▆▆▆▆▆▆▆▆▆▆▆▆▆▆▆▆. Second, it does not account for Pixel purchasers ▆▆▆▆▆▆ and individuals ▆▆▆▆▆▆ ▆▆▆▆▆▆▆▆▆▆.

EXPERT REPORT OF STEFAN BOEDEKER

2 Theoretical Framework of Economic Loss

13.   In this section, I describe the theory behind the economic loss model I propose to measure damages in this case. I use a generic example to describe in basic economic terms how prices are set for products based upon a consumer's willingness to pay and a manufacturer's willingness to accept and how economic loss can be tested if the demand for a product changes if one or more of the products attribute change. Finally, I will discuss how shifts in the demand curve, if they do exist, can be utilized to quantify class-wide economic losses.

2.1 Demand and Supply in a Competitive Market

2.1.1 Willingness-to-Pay

14.   In economic theory, willingness-to-pay is derived from "utility" and the consumers' budget. Utility describes a consumer's preferences and it is a measure of the value or usefulness of a good or service to that consumer.[4] To explain the concept, let us assume that it is known how much benefit or utility each consumer in a given market derives from a product or service and how much budget the consumer has available. The willingness-to-pay is the highest price a consumer is willing to pay for the product, which is based on the perceived utility derived from the product and the consumer's budget. The consumer will purchase the product if the market price of the product is lower than or equal to the consumer's willingness-to-pay, but the consumer will not purchase the product if the price is higher than the willingness-to-pay.

15.   In that sense, the individual willingness-to-pay for a product differentiates the buyer from the non-buyer for a certain product. There is no correlation between the individual willingness-to-pay and the market price. In this context, the marginal consumer is defined as the consumer whose willingness-to-pay equals the market price.

16.   In an illustrative example, let us assume a market with 10 consumers and that the consumer with the highest willingness-to-pay is willing to spend $1,100 for a smartphone. If the price of the product were $1,100, this consumer would purchase the product but nobody else would. This

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[4]   Hal R. Varian, Intermediate Microeconomics, 8th Edition, 2009, Page 54.

EXPERT REPORT OF STEFAN BOEDEKER

consumer would also buy the product for any price less than $1,100.[5] If there is an additional consumer with the next highest willingness-to-pay $950, then this consumer and the consumer with a willingness-to-pay of $1,100 would purchase at a price of $950, and so forth. Each consumer would buy the product at a price that is equal to or less than their respective willingness-to-pay. If the price is higher than a consumer's willingness-to-pay, then this consumer will not buy the product.

17.   Based on the ranking of consumers by their willingness-to-pay, a demand curve can be constructed in the following way: In a diagram that depicts the amount of the willingness-to-pay for each individual consumer on the vertical axis and the number of consumers on the horizontal axis, the demand curve will begin in the top left corner at the intersection of one consumer and a willingness-to-pay of $1,100. The next data point is at the intersection of two consumers and a willingness-to-pay of $950, and so forth.

18.   The demand curve would look like a downward facing set of stairs. For simplicity, textbooks typically stylize the demand curve as a smooth downward sloping line or curve. Figure 1 illustrates this concept.

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[5]   This is an important difference between the individual willingness-to-pay and the price actually paid. The actual value of the individual willingness-to-pay is irrelevant – only its relation to the price for the product matters: if the individual buys the product then the willingness-to-pay is at or above the price; if an individual does not buy the product then the willingness-to-pay is below the price.

EXPERT REPORT OF STEFAN BOEDEKER

Figure 1: Willingness-to-Pay and Demand
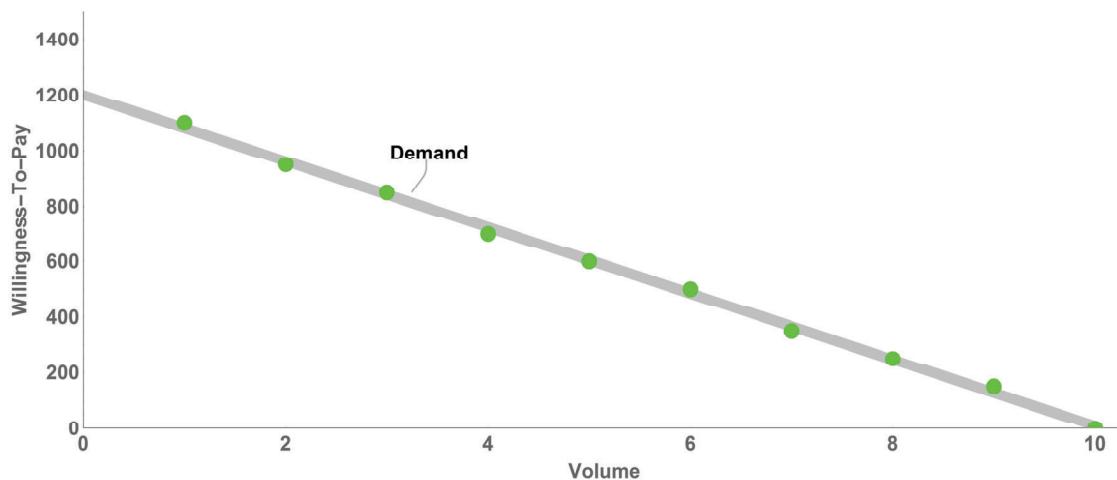
Source: Illustrative Example Based on Hypothetical Data

2.1.2   Willingness-to-Accept

19.   Following the same principle as in the example of developing the demand curve, we can also determine the minimum price at which each manufacturer is willing to sell the product. This is called the willingness-to-accept, which is equal to the marginal cost to the manufacturer. The marginal cost is the cost the manufacturer incurred when producing the last or marginal unit of the product.

20.   Like the consumers on the demand side, the manufacturers can be ranked by their willingness-to-accept. In a diagram with volume on the horizontal axis and prices and willingness-to-pay on the vertical axis, the manufacturer with the smallest marginal costs will be positioned on the left (let's say $100 in this example). If the price of the product were to be just above the marginal cost, only this manufacturer would be willing to accept the price. Assuming that the next manufacturer offers one unit for $200, then two units would be offered at the price of $200 in the market and so on. When connecting all ranked willingness-to-accept, we get the supply curve. It typically slopes upwards from left to right. The supply curve would look like an upward facing set of stairs. For simplicity, textbooks stylize the supply curve as an upward sloping smooth line or curve. Figure 2 below illustrates the concept.

EXPERT REPORT OF STEFAN BOEDEKER

Figure 2: Willingness-to-Accept and Supply
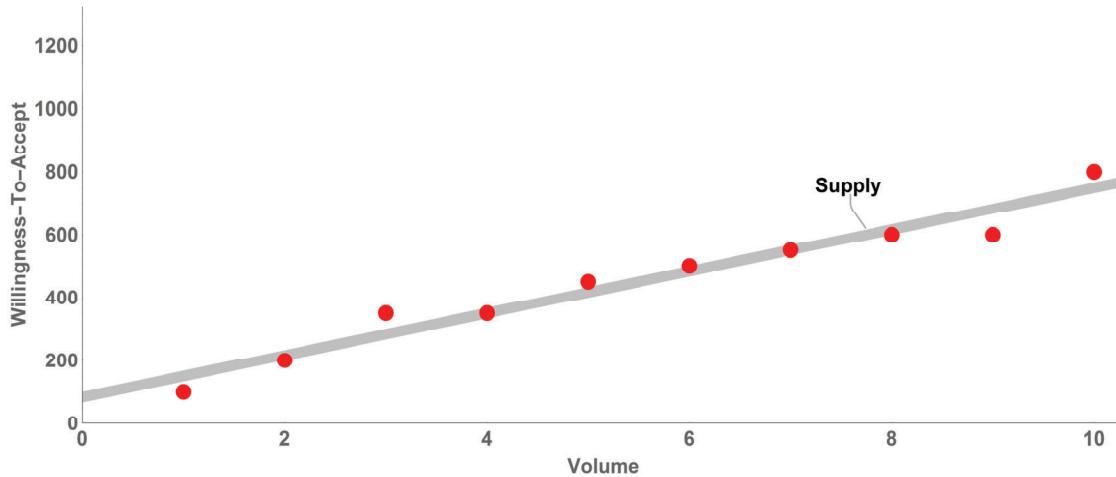
Source: Illustrative Example Based on Hypothetical Data

2.1.3   Market Equilibrium

21.   The market balances supply and demand. At a price of $200, almost all consumers in my example would purchase the product but the manufacturers would offer only one unit. Conversely, at a price of $1,000, only one consumer would be willing to purchase the product while all manufacturers would be willing to sell the product. In the generic example, the market clears at a price of $484. At this point, not all but most consumers and manufacturers will be brought together. In the graphical representation the supply and demand curves intersect (Figure 3). If the price exceeds $484, more manufacturers would offer their product but fewer consumers would be willing to purchase the product. If the price drops below $484, more consumers would be willing to purchase the product but fewer manufacturers would be willing to sell the product. The market equilibrium price of $484is the price at which every individual in the market for the product with a willingness-to-pay of $484or higher will buy, e.g., the individual on the demand curve represented by the left-most green dot with a willingness-to-pay of $1,100 will obviously not pay $1,100 when he/she can buy the product for $484. At the same time, the market equilibrium price of $484is the price at which every manufacturer of the product with a willingness-to-sell of $484or lower will sell.

EXPERT REPORT OF STEFAN BOEDEKER

Figure 3: Supply & Demand
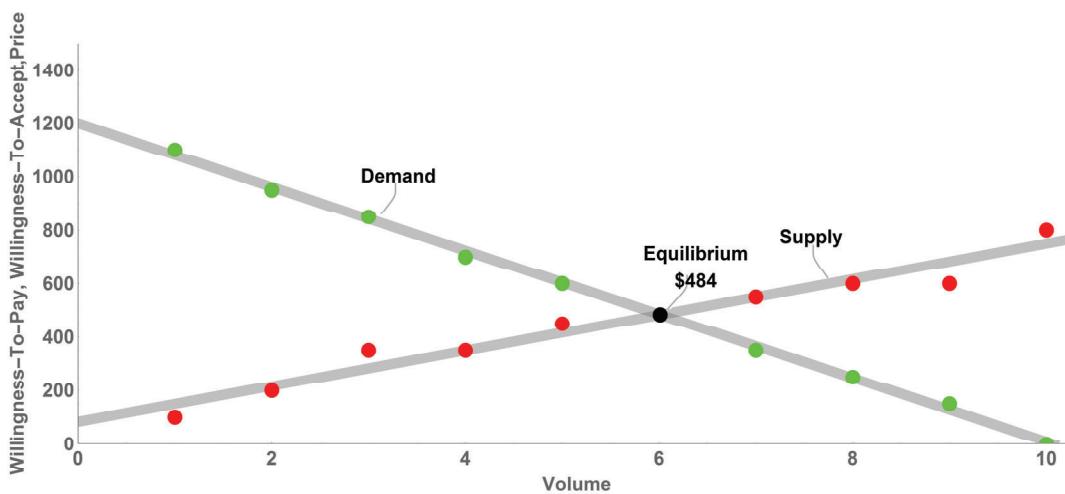
Source: Illustrative Example Based on Hypothetical Data

22.   The equilibrium price is not the simple average of all consumers' willingness to pay. Rather, the equilibrium price depends on supply and demand. The equilibrium price is the price where the supply curve and the demand curve intersect. Every consumer to the left of the marginal consumer has a willingness-to-pay that exceeds the equilibrium price, and therefore, will purchase the product.

23.   The difference between the willingness-to-pay and the market price can also be illustrated with a real-world example: In an eBay auction, I may have put my eye on an item. I put my upper limit for my bids at $50. This upper limit signals my willingness-to-pay. Given that willingness-to-pay, I will buy the item when I see it offered with a "Buy it Now" price tag of $25. What happened in this example? Did my utility from purchasing the item suddenly change? Did my willingness-to-pay change? Obviously not. However, what has changed is that the projected amount that I would pay going through the bidding process is different than the price I will pay when a competing offer with a lower price for the identical item is presented to me. In other words, the willingness-to-pay does not necessarily reflect the actual price that a consumer ends up paying for a product. Instead, the resulting market price is a function of the willingness-to-pay of all consumers in the market for a product and the individual customer's willingness-to-pay signals who will buy the product and who won't. Therefore, the economic loss measure introduced below based on prices derived from aggregate demand and not on individual willingness-to-pay.

EXPERT REPORT OF STEFAN BOEDEKER

24.   In the case of the Pixel, each time a consumer purchased a Pixel manufactured before ███████████ without being apprised of the Defect at or before the point of purchase or during the remorse period,[6] demand and supply for a Pixel without the Defect met and a market equilibrium resulted. Thus, all the consumers who purchased a Pixel manufactured before ███████ without being apprised of the Defect at or before the point of purchase represent the demand side of the market equilibrium, and the number of Pixels for which the Defect was not disclosed at or before the point of purchase represent the supply side of the market equilibrium.

2.2 Shifting Demand Curves and Changes in Equilibrium Price

25.   Based on Lancaster's theory of utility,[7] the utility a consumer derives from a product and, therefore, the consumer's willingness-to-pay for the product is aggregated from the willingness-to-pay for each of the product's characteristics, attributes, and features. In this case, the product is a Pixel and the characteristics of the product include, the power level, the size, design, functionality, price, and other features.[8]

26.   The price a consumer pays for a product is smaller than or equal to the consumer's willingness-to-pay for the product, and consequently, the price is also a weighted sum of the value of each individual attribute to the consumer. Changes in the composition of the attributes may lead to a shift of the demand curve for the product. In this case, the change in the composition of the attributes can relate to changes in tangible attributes such as a battery with 8 hours' talk time rather than 6 hours' talk time, or different colors. It can also relate to statements about the product and advertised features of the product that are used to market the product to the consumers such as having an aesthetically pleasing design.

27.   In the case where statements used for marketing purposes are alleged to be false and/or misleading or where important features like the Defect are omitted or concealed at or before the

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[6]   Deposition of Steven James at 95:3-15 ██████████████████████████████████████ ███████; https://support.google.com/store/answer/2411741?hl=en; https://www.verizonwireless.com/one-support/return-policy/.

[7]   Lancaster, Kelvin J. (1966), "A New Approach to Consumer Theory," Journal of Political Economy 74 (2): Pages 132–157.

[8]   See the detailed discussion in Section 5.3.

EXPERT REPORT OF STEFAN BOEDEKER

point of purchase[9], it must be determined if and by how much the demand curve shifts when the truth about the Defect is revealed at or before the point of purchase.[10] If based on the now complete information at the point of purchase the demand curve shifts downward because the consumers find the product with the complete information less desirable, the price and quantity of the product may be lower – i.e., fewer consumers will buy at a lower price. Figure 4 below illustrates a possible demand curve shift downward for this scenario:

Figure 4: Shift in the Demand Curve and the Effect on the Equilibrium Price
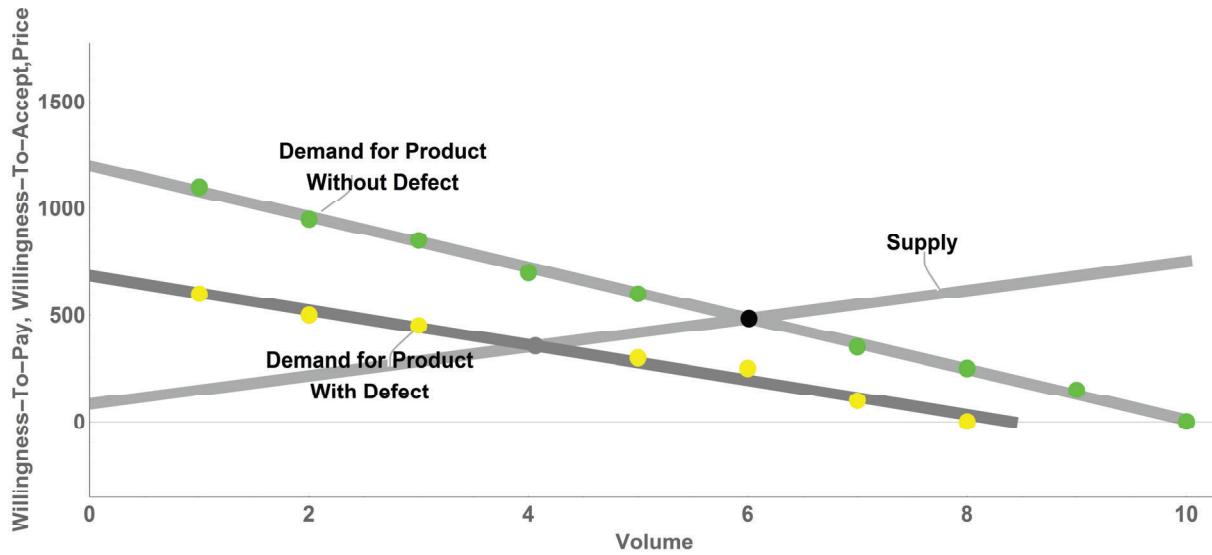
Source: Illustrative Example Based on Hypothetical Data

28.   In the following paragraphs, I will refer to the situation where the consumer bought a product with incomplete information as the "actual world" and the situation where the consumer had full information about the product at the point of purchase "but-for world." In this case, the actual world is the world where consumers bought the Pixel with the Defect without knowing about the Defect; and the but-for-world is the hypothetical world where consumers are informed at the point of purchase about the Defect.

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[9]   In the following, I will refer to situations where statements used for marketing purposes are alleged to be false and/or misleading or where important features like design flaws are omitted or concealed at the point of purchase as situations where the consumer has *incomplete information* at the point of purchase.

[10]   In *In re MyFord Touch Consumer Litig.,* the Court accepted my approach to calculate how information about a defective information system revealed at the point of purchase would lead to a drop in the price premium that consumers would pay for vehicles with the infotainment system compared to vehicles that didn't have an infotainment system.

EXPERT REPORT OF STEFAN BOEDEKER

29.   In the but-for-world, where consumers find out about the Defect at the point of purchase their demand for the Pixel may change. If the disclosure of the Defect at the point of purchase in the but-for-world makes the Pixel less attractive or desirable to the consumer, then they may be willing to pay less for the Pixel resulting in a downward shift of the demand curve. Figure 4 above illustrates such a demand shift.

30.   The new demand curve may have a different shape than the demand curve for the product in the actual world where the consumer does not know about the Defect. All else equal, the shift of the demand curve results in a new market equilibrium, where the price and the transaction volume are lower. This is the new market equilibrium in the but-for world. However, the new market equilibrium occurs at a lower price and at a lower volume. Considering that the horizontal volume axis represents the members of the putative class this new market equilibrium is not the relevant measure for the economic loss.

31.   Before I derive the correct measure for economic loss based on the economic principles discussed in this Section, I will present an economic argument that proves that the manufacturer gains at the cost of the consumer in cases when a product is sold and certain information is not disclosed to the consumer at or before the point of purchase or during any applicable grace period (and that the manufacturer gains at the cost of the consumer in cases when the previously undisclosed information makes the product less attractive and less desirable to the consumer such that the demand curve shifts downward).

32.   In economic theory, the consumer's surplus purchasing a given product is the difference between the willingness-to-pay and the price paid. Aggregated across all consumers in a market, this is defined as the consumers' surplus[11]. It is equal to the area under the demand curve and above the price line (red area and dark orange area in Figure 5). If the disclosure of complete information for a product at the point of purchase makes the product less desirable for the consumer, then the demand curve will shift downwards (dark grey line in Figure 5). The new consumer surplus after the shift in the demand curve due to the false claim is equal to the area under the new demand curve and above the new price line (light orange area in Figure 5).

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[11]   Hal R. Varian, Intermediate Microeconomics, 8th Edition, 2009, Page 255.

EXPERT REPORT OF STEFAN BOEDEKER

Figure 5: Consumers' Surplus for Product With and Without Defect
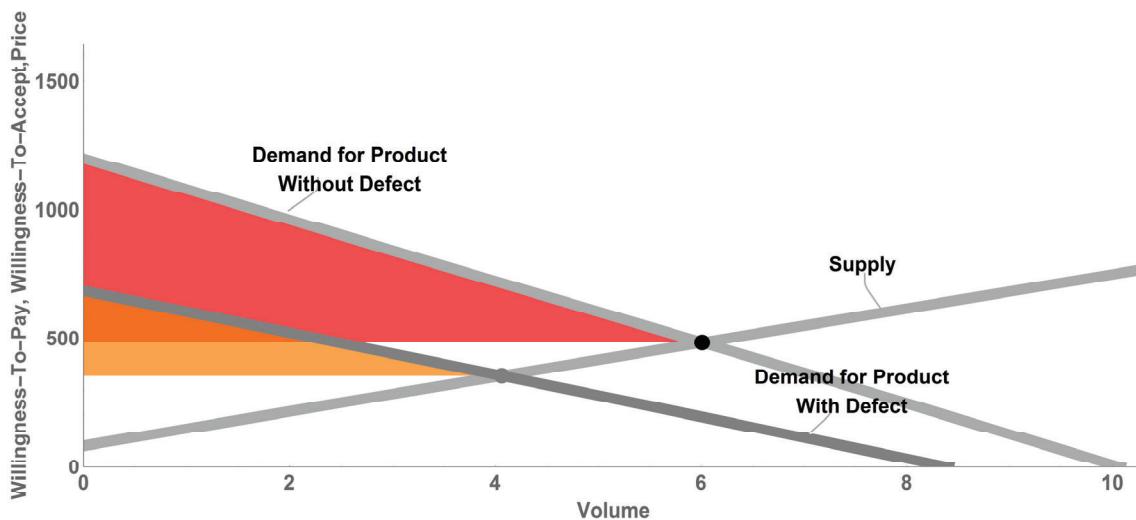
Source: *Illustrative Example Based on Hypothetical Data*

33.   If the demand curve for the product with full information in the but-for-world is below the demand curve for the product where some information has not been disclosed in the actual world (the demand curve labeled "Demand for Product in Actual World" is above the demand curve labeled "Demand for Product in But-For-World" in Figure 5), the consumer surplus for the product in the but-for-world will be smaller than the consumer surplus in the actual world. Therefore, the consumers will have suffered economic losses.

34.   Another way of looking at the economic loss to the consumer focuses on the manufacturer. Generally, a manufacturer's surplus is the difference between the willingness-to-accept and the price obtained in the market. Aggregated over all manufacturers, the manufacturers' surplus is the area below the price line and above the supply curve.

35.   Corresponding to the consumers' surplus, we can also derive the manufacturers' surplus.[12] For each unit, the manufacturer's surplus is the difference between the price received and the marginal costs of producing the unit. A shift in the demand curve results in a change in the manufacturer's surplus. In Figure 6 below, the difference in manufacturers' surplus in the actual world when certain information is concealed at the point of purchase and in the but-for-world when

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[12]   Hal R. Varian, Intermediate Microeconomics, 8th Edition, 2009, Page 313.

EXPERT REPORT OF STEFAN BOEDEKER

the information is disclosed is depicted by the yellow area. Recall, that in the hypothetical example, the equilibrium between supply and the demand for the product with incomplete information in the actual world resulted in six consumers paying $484 (see Figure 3). In the market equilibrium depicted in Figure 6, for the product in the but-for-world with full information at the point of purchase, four consumers (instead of six) would have paid $354 instead of $484. The yellow area in Figure 6 depicts the additional manufacturers' surplus obtained by not disclosing that the claim was false. Therefore, the manufacturer gains at the cost of the consumer.

Figure 6: Producers' Surplus for Product with and Without Defect
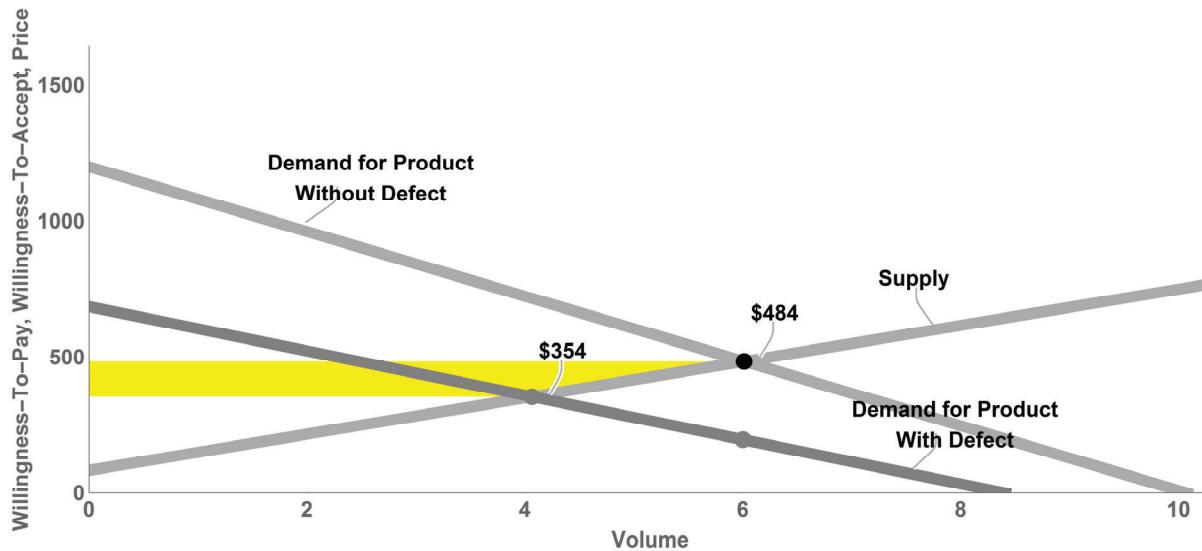
Source: Illustrative Example Based on Hypothetical Data

2.3   A Model of Economic Loss

36.   Figure 5 and Figure 6 clearly show how the concealment of information that would change the demand for a product increases the manufacturer's gross profits at the expense of consumers. In the example above, at the new equilibrium price of $354 the volume sold drops to four units. The fact that only four instead of six consumers would have bought the product at the new market equilibrium price of $354 implies that the new market equilibrium price is not an adequate measure to compensate for the economic loss.

37.   In the illustrative example in Figure 7 below, the new market equilibrium (i.e., where demand and supply for the product with all information disclosed at the time of purchase intersect)

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EXPERT REPORT OF STEFAN BOEDEKER

occurs at a lower price ($354 instead of $484) and at a lower number of units sold (four instead of six). Therefore, the price of $354 does not clear all six purchasers who bought the product in the actual world not having all the information about the product when making their purchase decision.

38.   To fully compensate all consumers for their economic loss, it is necessary to find the price point on the demand curve that ensures that the same number of units that were sold in the actual world would also be sold in the but-for-world. This can easily be achieved by shifting up the demand curve in the but-for-world to where the but-for-world demand curve intersects with the original supply curve in the original market equilibrium. As can be seen in Figure 7, six consumers would have purchased the product at $196. Hence, providing the six consumers with a compensation of $289, which is the difference between $484 and $196, fully compensates each member of the putative class.[13] The supply curve is only relevant to determine the market equilibrium in the actual world. The supply curve in the but-for world and any change of the supply curve in the but-for world is irrelevant for the determination of economic loss as the economic loss only depends on the original market equilibrium and information on the shape and position of the demand curve in the but-for world.

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[13]   In Sections 4 to 6, I will describe a methodology to calculate the shift of the demand curve and assess the economic loss based on an empirical study.

EXPERT REPORT OF STEFAN BOEDEKER

Figure 7: Compensation Required to Compensate Consumers for Their Losses After Purchasing Product with the Undisclosed Defect
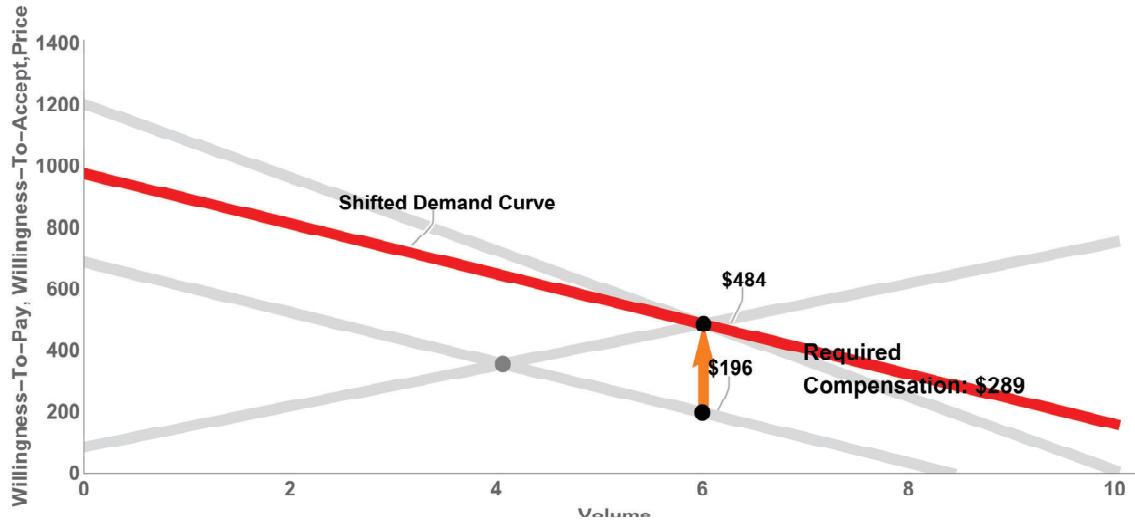
Source: Illustrative Example Based on Hypothetical Data

2.4   Consideration of the Supply Side in the Economic Loss Model

39.   The supply curve in the economic loss model is identical for the actual world (no disclosure of the Defect) and the but-for world (the same Pixels are now offered with full disclosure of the Defect at the point of purchase in the but-for-world). In the actual world, the supply of Pixels is defined by the number of Pixels sold for which the Defect had not been disclosed at the point of purchase. This supply is relevant to the economic loss computation. If consumers' preference changes once the Defect is disclosed at the point of purchase, then the number of sold Pixels with the previously undisclosed Defect are the supply in the but-for-world where the Defect was disclosed at the point of purchase. The shift in the attribute level (i.e., previously undisclosed Defect are now disclosed at the point of purchase) has no impact on the marginal costs of the supplier, and therefore, the supply curve remains the same. Consequently, only the changes in the demand curve are relevant for the assessment of an economic loss to the consumers, if any.

40.   Because the economic loss model must find the price for the volume of Pixels supplied in the actual world (i.e., the number of sold without disclosing the Defect) that consumers would have paid in the but-for world (i.e., where the consumers know about the Defect), the supply in the actual and the but-for world is identical. Therefore, the only relevant question is if the

EXPERT REPORT OF STEFAN BOEDEKER

disclosure of the Defect at or before the point of purchase makes the Pixels actually sold inferior to the Pixels as advertised in the eyes of the consumer.

41.   If the consumers' perception changes such that the Pixels with the Defect are viewed as inferior, then the demand curve will shift downwards. This implies that for an upward sloped supply curve, the downward shift of the demand curve is associated with a drop in the price that consumers would pay if they knew at the point of purchase that the Pixels have the Defect.

3   The Market for Smartphones

42.   The market for smartphones started with the Blackberry phones in the early 2000 but accelerated with the release of the original iPhone in June 2007.[14] Since then advancements in data transfer rates from GPRS to 3G and LTE went hand in hand with the advent of more powerful smartphones. These smartphones all feature touchscreens, that allow the user to access various customizable applications, including email and messaging.

43.   In the United States, Apple was able to translate its technological lead into a market share of 40% as of Q2 2018.[15] Samsung, which had been embroiled in a major patent dispute with Apple over the design of its smartphones,[16] maintained 25% market share, followed by LG and Motorola. All leading manufacturers but Apple rely on Google's Android operating system, which the manufacturers customize according to their needs and perceived customer preferences.

44.   Google had purchased Android from the original developers in 2005. By the end of 2007, Google released the Android operating system.[17] HTC was the first handset manufacturer to use Android as the smartphone's operating system. In 2010 Google introduced its first smartphone, Nexus.[18] In 2016 Google introduced Pixel, a premium smartphone designed to highlight the

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[22]   *See*, for example: Rao, Vithala, Applied Conjoint Analysis, Springer-Verlag, 2014.
[22]   *See*, for example: Rao, Vithala, Applied Conjoint Analysis, Springer-Verlag, 2014.
[22]   *See*, for example: Rao, Vithala, Applied Conjoint Analysis, Springer-Verlag, 2014.
[22]   *See*, for example: Rao, Vithala, Applied Conjoint Analysis, Springer-Verlag, 2014.
[22]   *See*, for example: Rao, Vithala, Applied Conjoint Analysis, Springer-Verlag, 2014.

EXPERT REPORT OF STEFAN BOEDEKER

capabilities of the Android operating system.[19] Google sold approximately 3.9 million Pixel smartphones in 2017 – a fraction of what Apple or Samsung sold.[20]

45.   Smartphones are generally either sold to consumers through their mobile phone service providers, which in the United States include Verizon, AT&T and T-Mobile, through online purchase portals, or through retailers, including BestBuy, Target and Amazon. Only Apple has its own brick-and-mortar retail outlets – the Apple Stores. Some mobile phone service providers offer discounts for phones when consumers trade-in an older phone or commit to long-term contracts or when they switch providers. Verizon has been the only mobile phone providers to sell Google Pixel smartphones.[21] Google also sells the Pixel directly to consumers through its website and through its carrier, Project Fi.

4   Choice Based Conjoint Analysis

4.1   Introduction of Conjoint Analysis

46.   An economic model that applies the theory discussed above is conjoint analysis. Conjoint analysis is widely used in market research and is discussed in depth in market research literature.[22] For example, Vithala Rao's book, *Applied Conjoint Analysis*, provides numerous examples of the widespread use of Conjoint Analysis including, but not limited to, several high-profile applications by large corporations and large public agencies such as (i) Microsoft for pricing newly released software products, (ii) Procter & Gamble for consumer-goods pricing and new product development, (iii) Marriott Corporation for the development of the Courtyard hotel brand, and (iv) T-Mobile for developing optimal cellular plans. Conjoint Analysis was also integral to the development of the EZPass electronic toll collection system by regional transit agencies in New York and New Jersey in the 1990s.[23]

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[22]   *See*, for example: Rao, Vithala, Applied Conjoint Analysis, Springer-Verlag, 2014.
[22]   *See*, for example: Rao, Vithala, Applied Conjoint Analysis, Springer-Verlag, 2014.
[22]   *See*, for example: Rao, Vithala, Applied Conjoint Analysis, Springer-Verlag, 2014.
[22]   *See*, for example: Rao, Vithala, Applied Conjoint Analysis, Springer-Verlag, 2014.
[23]   Ibid., Chapters 6.4 and 6.5.

EXPERT REPORT OF STEFAN BOEDEKER

47.   Bryan Orme, the founder of Sawtooth software for conjoint analysis, estimates that over 18,000 commercial applications of Conjoint Analysis take place each year.[24] Ten individuals from corporate research and marketing departments, academics, and governmental agencies including among others Boing, General Motors, Lifetime Products, Microsoft, Procter and Gamble, Yale University, University of Michigan, and a branch of the Canadian Department of Fisheries and Oceans contributed their experiences in applying Conjoint Analysis to answer a diverse range of questions including among many others interaction of product attributes, product pricing, new product development, strategic market planning, choice of complex medical treatments, pricing of product bundles, and how changes in attributes affect prices.[25]

48.   In addition to simply reporting the use of Conjoint analysis, the contributors to the Orme book also praise the success of applying Conjoint Analysis, noting for example that "the vast majority of conjoint conclusions have proven correct over time…"[26] "In the fall of 2004, McMaster University introduced the new Compass Curriculum – an approach to medical education consistent with the results of this conjoint experiment,"[27] and "Conjoint has helped the company to maintain growth in mature markets and provide better products at the best possible prices. We look forward to expanding our use of conjoint analysis as an effective management-information tool."[28]

49.   The central idea behind Conjoint Analysis is that consumers' preferences for a particular product are driven by attributes, features, or descriptions or advertisements of attributes or features embodied in that product. Using survey data, Conjoint Analysis is a set of econometric and statistical techniques that have been developed to study consumers' decision-making processes, determining trade-offs between products, features, and price, as well as quantifying consumers' gains and/or losses of utility when choosing between different alternatives. By simulating real world and/or hypothetical choices between product features and prices under different levels of information, Conjoint Analysis is ideally suited to model the impact of different choice scenarios

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[24]   Orme, Bryan K, Getting Started with Conjoint Analysis: Strategies for Pricing Research, 3rd ed., Madison: Research Publishers, 2014, Page 143.
[25]   Ibid., Chapter 14.
[26]   Ibid., Page 146.
[27]   Ibid., Page 150.
[28]   Ibid., Page 157.

EXPERT REPORT OF STEFAN BOEDEKER

on a consumer's utility function. It has been accepted as a methodology sufficient to measure class-wide damages in similar product defect and false advertising cases across the country. [29]

50.   The data required to optimize a Conjoint Analysis are collected in the setting of a survey where survey participants are shown several product profiles with different levels of each attribute. The survey participants are consumers who currently are or recently have been in the market for the product of interest – in this case, smartphones with Android operating system.[30] After reviewing a set of choice menus of product attributes and their levels, survey participants are then asked to indicate their preferences for those profiles. The product profiles include choice options for different price points for each set of features on the choice menu.

51.   After the completion of the survey, the Conjoint Analysis uses data from the survey on the attribute levels of the product profiles shown, and the resulting preferences or choices of respondents, to decompose the respondents' preferences for a product into the partial contribution of these attribute levels ("part-worths") using appropriate statistical methods. The statistical models used in my analysis – Mixed Logit Models and Hierarchical Bayesian Estimation – will be discussed in more detail in Section 6 "Economic Loss Model." These statistical estimation techniques quantify the part-worths for feature levels such that the resulting estimated part-worths best predict respondents' preferences or choices from the survey. By adding up the part-worths by respondent for different attribute levels one can determine the share of respondents that would have purchased the product made up of the different levels of each attribute and a given price.

52.   The price reduction needed to compensate for the loss of a feature, or the additional price customers would pay for the inclusion of a feature can then be calculated and a variety of choice situations and trade-offs between choices can be modeled and their outcomes can be precisely quantified. The precision, and thus the reliability, of the resulting estimations depends on the

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29   See e.g., In Re Arris Cable Modem Consumer Litigation, No. 5:17-CV-01834-LHK, 2018 U.S. Dist. LEXIS 136617 (N.D. Cal. Aug. 10, 2018); Fitzhenry-Russell v. Dr. Pepper Snapple Group, Inc., No. 5:17-cv-00564 (N.D. Cal. June 26, 2018); Khoday v. Symantec Corp., 93 F. Supp. 3d 1067, 1082 (D. Minn. 2015). See also TV Interactive Data Corp. v. Sony Corp., 929 F. Supp. 2d 1006, 1026 (N.D. Cal. 2013); Sanchez-Knutson v. Ford Motor Company, 181 F. Supp. 3d 988, 995 (S.D. Fla. 2016); Dzielak v. Whirlpool, 2017 WL 6513347 (D.N.J. Dec. 20, 2017); In re ConAgra Foods, Inc., 90 F. Supp. 3d 919 (C.D. Cal. 2015); In Re: Dial Complete Marketing and Sales Practice Litig., 320 F.R.D. 326 (D.N.H. 2017).
30   I describe in Section 5.3 in more detail why I choose respondents who have purchased Android smartphones rather than just Pixel users.

EXPERT REPORT OF STEFAN BOEDEKER

number of survey participants. The more respondents take part in the survey, the more precise the resulting predictions are.

53.   For this assignment, I will apply a form of Conjoint Analysis known as Choice-Based Conjoint Analysis ("CBC"). In CBC, study participants are shown sets of product profiles (called "choice sets" or "choice menus") and are asked to choose the profile that they would prefer to purchase if the choice menu offered would describe the only products that were available to them. CBC survey methods closely mimic real-world purchase processes.[31] Conjoint Analysis allows for the prediction of the probability that a respondent will choose any product profile that is described by the part-worths and can do so for any competitive set of products.[32] Based on the estimations, it is also possible to simulate how choice shares would change in a market based on a change in overall price. CBC enables us to determine the difference in value (both, measured in dollars or as a percentage of the purchase price in the Actual World) that customers place on a smartphone without Defect compared to an otherwise identical smartphone with Defect.

4.2   Choosing Attributes and Levels in Conjoint Analysis

54.   The choice of attributes and their respective levels is an important aspect of proper conjoint study design. An attribute is a characteristic of a product which is comprised of different levels. There must be at least two levels. In its simplest form an attribute is binary and may indicate that a product has a certain characteristic or not (e.g., a product may be compatible to 5G or not). As discussed in Section 3, economic theory holds that buyers view products as composed of various attributes and levels. Buyers place a certain utility (value) on each of those attributes and levels, and the overall utility of any product is the weighted sum of the value of its attributes and levels.[33]

55.   In statistical data analysis, there are typically four scales that measure the levels of attributes:

    a.   Nominal scales,

    b.   Ordinal scales,

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[31]   Orme, Bryan, Getting Started with Conjoint Analysis: Strategies for Pricing Research, 3rd ed., Madison: Research Publishers LLC, 2014.

[32]   Allenby, Greg M & Peter E Rossi, "Hierarchical Bayes Models," in Grover, Rajiv & Marco Vriens, eds., The Handbook of Marketing Research, Thousand Oaks: Sage Publications, Inc., 2006.

[33]   Orme, Bryan K., Formulating Attributes and Levels in Conjoint Analysis, Sawtooth Software Research Paper Series, 2002.

EXPERT REPORT OF STEFAN BOEDEKER

      c.   Interval scales, and

      d.   Ratio scales.

Interval scales and ratio scales are often summarized as quantitative scales.

56.   Nominal scales are used for labeling variables where the labels have no quantitative meaning (e.g., the color of a smart phone). When using attributes measured on a nominal scale the levels of these attributes are mutually exclusive (no overlap) and none of them have any numerical significance.

57.   When using ordinal scales, the order of the values has importance and significance, but the differences between the values are meaningless. For example, when Pixel purchasers are asked how satisfied they were with their product and the answer choices are on a scale from 1 – 5 where 5 means "very satisfied", 4 means "satisfied", 3 means "neither satisfied nor dissatisfied", 2 means "dissatisfied" and 1 means "very dissatisfied", there is a clear order but the values from 1 to 5 have no quantitative meaning (e.g., the difference between 5 and 3 is the same as between 4 and 2 but does not translate into the difference between "very satisfied" and "neither satisfied nor dissatisfied" to be the same as the one between "satisfied" and "dissatisfied"). All that can be concluded from an ordinal scale is if a choice is better (4 is better than 2 and 5 is better than 3) when measuring customer satisfaction but it cannot be concluded or quantified how much better it is.

58.   Interval scales provide the order of values and the ability to quantify the difference between each one. An example of an interval scale is temperature measured in Fahrenheit because the same quantitative difference between each set of value is the same. For example, when the temperature is 60 degrees then it is 10 degrees warmer than when the temperature is 50 degrees and when the temperature is 80 degrees then it is also 10 degrees warmer than when the temperature is 70 degrees. However, it cannot be concluded that 80 degrees is twice as a warm as 40 degrees or 10 degrees is five times colder than 50 degrees because an objective zero point is not defined.

59.   Ratio scales are identical to interval scales with the additional characteristic that an objective zero point can be defines. Price data are on a ratio scale – a product for $100 is twice as expensive than a product for $50 and a product for $50 is twice as expensive as a product for $25.

EXPERT REPORT OF STEFAN BOEDEKER

For measurements on a ratio scale, it can now be concluded that the product for $100 is 2 x 2 = 4 times as expensive as the product for $25. These calculations are not possible on the measurements on the other scales.

60.   Attributes can be nominal (e.g., the color or brand of the product) where it is unclear what consumers value more, ordinal (e.g., the version of the operating system) where there is an a priori expectation about consumers' preferences, and attributes can be quantitative, i.e., interval or ratio scale (e.g., the price of the smartphone is on a ratio scale).

61.   The literature recommends that Choice Based Conjoint studies involve about six or fewer attributes, each comprised of two to five levels to address issues of fatigue and general ability of respondents to process information. In his seminal publication on conjoint analysis, Rao discusses the number of choices represented on one choice menu. He states that some authors believe that the number of cells on a choice menu (number of columns times number of rows) should not exceed twenty while others tend to favor the notion that respondents are not hard pressed to process more pieces of information.[34]

62.   It is further recommended[35] to conduct a pre-test survey before the actual conjoint study to elicit consumers' preferences with respect to attributes and the importance of those attributes in the process of purchasing a product. The results from the pre-test survey will then guide the choice of attributes for the conjoint study. Following this approach, I conducted a pre-test survey which will be discussed in detail in Section 5.3.

4.3 Statistical Estimation Techniques Applied in Conjoint Analysis

63.   The underlying econometric and statistical estimation techniques of the Conjoint Analysis are based on Mixed Logit models and Hierarchical Bayesian Estimation techniques, which are widely employed in economics and marketing research to analyze preferences over a discrete set of choices.[36]

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[34]   Rao, Vithala, Applied Conjoint Analysis, Springer-Verlag, 2014, Pages 132-133.
[35]   See the general survey methodology literature cited in Footnote 48.
[36]   Underlying the Mixed Logit is a model of random utility. *See* Hal Varian, Intermediate Microeconomics, 8th Ed, 2009, Page. 68.

EXPERT REPORT OF STEFAN BOEDEKER

64.   Mixed Logit models are based on the idea that each consumer assigns a utility to each choice, and this utility measures the attractiveness of each choice. These utility values are correlated with the attributes of the actual choice (for example, including a battery with a higher capacity in a smartphone) and the price associated with that choice. The utilities can be correlated with observable characteristics of the consumers making the choice (such as their age or income).

65.   The utility of each product consists of two components – a deterministic component and a random component. The deterministic component can be modeled by observable factors such as socio-economic and demographic characteristics of the consumers, product features, and market conditions. In general terms, the random component summarizes all the unobservable factors in the individual consumer's choice process. In Mixed Logit models, the random component is expressed through a logistic distribution function. Together with the observable factors, this distribution function is used to predict the probability that a particular choice is made.[37]

66.   Once shown a menu of choices of different levels of attributes and different price alternatives, the consumer then chooses the one choice in the menu that yields the highest utility from that menu of choices.[38] Observing consumers' choices from various choice menus enables one to estimate the relative value consumers place on one attribute over another. The inclusion of price as an attribute allows for the estimation of the value of an attribute and its levels. For example, with the inclusion of price it can now be tested how much value consumers place on properly functioning smartphone audio compared to the defective audio functionality alleged in the Complaint.

67.   Bayesian statistics is a field of statistics where the underlying model parameters are assumed to be random variables rather than fixed quantities. Bayesian modelling is based on assigning prior probability distributions to any unknown parameters. In this case, the unknown parameters to be estimated are the part-worths of the attributes of a composite product derived

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[37]   *See*, for example: Rao, Vithala, Applied Conjoint Analysis, Springer-Verlag, 2014, Chapter 4, for a detailed discussion of the use of mixed multinomial logit models in choice based conjoint studies.
[38]   *See* Figure 16 for an example of what a choice menu might look like where a respondent is presented a menu with five choices of combinations of features. Afterwards respondents are asked whether they would purchase the preferred option

EXPERT REPORT OF STEFAN BOEDEKER

from the choice sets in the conjoint analysis. These parameters are estimated by a technique referred to in the literature as Hierarchical Bayesian Estimation.[39]

68.   In Hierarchical Bayes Estimation ("HBE"), the parameter estimates are derived in a two-step hierarchical approach. At the higher level, the individual consumers' part-worths are assumed to follow a specified distribution (like multivariate normal distribution or log-normal distribution). At the lower level, it is assumed that the individual consumers' choice probabilities can be described by a model, such as a Mixed Logit model. Initial estimates of part-worth are estimated for each study respondent to use as a starting point. New estimates are updated using an iterative process called "Gibbs Sampling" and "Metropolis Hastings Algorithms."[40] This process is typically repeated thousands of times whereby in each iteration, an estimate is made for each parameter, conditional on current estimates of the others. After many iterations, this process converges to the correct estimates for each of the parameters.

69.   The HBE method combines random effect specifications at the aggregate level to account for variation across individuals and specific modelling of choice probabilities at the individual level. With market simulations, the performance of competing alternatives can be evaluated.

4.4 Hedonic Pricing Analysis as a Potential Alternative to Conjoint Analysis

70.   Based on the theory described above, in order to estimate class-wide damages one has to design an empirical approach to determine the demand for Pixel Phones had consumers known about the Defect at the time and point of purchase. One could ask consumers directly, how much they were willing to spend on a Pixel with a defective microphone. That is not my method, as direct questions are likely to lead to strategic responses that might overstate the difference in willingness-to-pay for a product with or without the Defect.

71.   In general, there are two different types of approaches to estimate the values of the individual characteristics, parts, and features that together form a composite product when there is

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[39]   *See*, for example: Rao, Vithala, Applied Conjoint Analysis, Springer-Verlag, 2014, Chapter 4.11, for a detailed discussion of the use of Hierarchical Bayesian Estimation in choice based conjoint studies.
[40]   Rao, Vithala, Applied Conjoint Analysis, Springer-Verlag, 2014, Page. 168.

EXPERT REPORT OF STEFAN BOEDEKER

no direct market for the individual characteristics, parts, and features (also known as attributes; price is also considered an attribute of a product) themselves:

    a.   Stated Preference based, and

    b.   Revealed Preference based.

72.   Stated Preference based approaches involve asking individuals directly or indirectly how much they value a particular product. This is done by investigating how much they would be willing to pay for an attribute/feature in a composite product. In this context, Conjoint Analysis is an approach exploring respondents' preferences over multiple sets of choices, which produces rich data sets and numerous data points from which to estimate the value of the attribute/feature of interest. Conjoint Analysis builds on a survey where demographic, socio-economic, and general decision-making processes and preference information about the product in question can be collected and integrated into the Conjoint Analysis.

73.   The particular strength of Conjoint Analysis is the fact that the stated preferences are derived from indirect questions where study participants are shown choice sets with varying attributes at different price points without being explicitly asked to name a price for a specific attribute, thereby avoiding the pitfalls of strategic responses in direct questioning. I am of the opinion that a conjoint analysis would be very well suited to estimate class-wide damages in this case.

74.   Revealed Preference based approaches observe actual purchases by consumers or published prices and infer from that information the decomposition of the overall price of the composite product into its constituent attributes. This is most often accomplished by using hedonic pricing models where the actual transaction prices of the composite product with varying attributes is regressed on the specifications of the composite product. The regression coefficients are then interpreted as the implicit market prices of each attribute. The Hedonic Pricing approach was

EXPERT REPORT OF STEFAN BOEDEKER

developed by Andrew Court[41] in 1939 and expanded by Zvi Griliches[42] [43], Sherwin Rosen[44], Jack Triplett[45] [46], Robert Feenstra[47] and many others.

75.   The Hedonic Pricing Approach assumes a utility function as first described by Lancaster, in which the utility derived from a certain product is a function of its attributes. When consumers can choose the level of each attribute, they will consume more of a specific attribute until the marginal utility equals the marginal increase in the price of the product, which is also called the implicit price of the attribute.

76.   On the supply side, it is assumed that the production cost function is also dependent on the various attributes. Under perfect competition, the manufacturer will increase the level of each attribute until the marginal cost of the attribute is equal to the marginal increase in price that the manufacturer can achieve in the market.

77.   In market equilibrium with perfect competition, the marginal cost of the attribute is equal to the marginal utility and the implicit price of the attribute. This relationship can be used to extract from observable market prices and attribute levels the implicit price of a specific attribute. The implicit price of the attribute is equal to the partial derivative of the hedonic price function to the attribute. The hedonic equation can be estimated from market data, where the observed price of the composite product is a function of the vector of the descriptive attributes and the implicit price

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[41] Court, Andrew T. (1939), "Hedonic Price Indexes with Automotive Examples", in: The Dynamics of Automobile Demand, New York, NY: General Motors Corporation, pp. 99-117.
[42] Griliches, Zvi (1961), "Hedonic Price Indexes for Automobiles: An Econometric Analysis of Quality Change", in: Price Statistics Review Committee, National Bureau of Economic Research, The Price Statistics of the Federal Government: Review, Appraisal, and Recommendations, General Series No. 73. New York, NY: National Bureau of Economic Research, pp. 173-96, reprinted in Zvi Griliches, Technology, Education, and Productivity, Oxford: Basil Blackwell, 1988, pp. 76-104.
[43] Griliches, Zvi (1990), "Hedonic Price Indexes and the Measurement of Capital and Productivity: Some Historical References", in: Ernst R. Berndt and Jack E. Triplett (eds.), Fifty Years of Economic Measurement: The Jubilee of the Conference on Research in Income and Wealth, National Bureau of Economic Research Studies in Income and Wealth, Vol. 54. Chicago: University of Chicago Press, pp. 185-202.
[44] Rosen, Sherwin (1974), "Hedonic Prices and Implicit Markets: Product Differentiation in Pure Competition", Journal of Political Economy, 82(1) (January-February), pp. 34-55.
[45] Triplett, Jack E. (1969), "Automobiles and Hedonic Quality Measurement", Journal of Political Economy, 77(3) (May-June), pp. 408-17.
[46] Triplett, Jack (2006), Handbook on Hedonic Indexes and Quality Adjustments in Price Indexes: Special Application to Information Technology Products, OECD Publishing, Paris. DOI: http://dx.doi.org/10.1787/9789264028159-en
[47] Feenstra, Robert C. (1995), "Exact Hedonic Price Indexes", Review of Economics and Statistics, 77(4) (November), pp. 634-53.

EXPERT REPORT OF STEFAN BOEDEKER

vector. The Hedonic Pricing approach requires information about descriptive attributes of the product, information on the prices paid by consumers for the products and information on volumes sold. Often, this information is derived from transactional data.

78.   I reserve the right to conduct a hedonic regression analysis as may be appropriate at a later point in this case.

5   Empirical Study

5.1   General Survey Methodology

79.   Unlike in accounting where "Generally Accepted Accounting Principles" (GAAP) include the standards, conventions, and rules that accountants follow in recording and summarizing financial data in an audit for the preparation of financial statements, there is not one authoritative list of such generally accepted principles for survey methodology and its proper application. In survey sampling there is no one-size-fits-all solution. However, various authors[48] and different professional organizations[49] have agreed what is necessary to properly design and implement surveys, and then statistically analyze their results such that reliable and valid conclusions can be drawn and applied to the broader target population of interest.

80.   In the following I will give an overview of general survey methodology. Obtaining data through surveys is a frequently used data collection tool. In general, survey research has to go through the following three steps to yield meaningful and reliable results:

   a.   Survey Design;
   b.   Survey Implementation; and
   c.   Statistical Analysis and Presentation of survey results.

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[48]   There is voluminous literature about survey research defining the relevant steps in proper survey research. The following two books are excellent resources:
   a.   Handbook of Survey Research, J. Wright, P. Marsden, 2nd Edition, 2010.
   b.   Survey Methodology (Wiley Series in Survey Methodology), Robert M. Groves, Floyd J. Fowler Jr., Mick P. Couper, James M. Lepkowski, Eleanor Singer, Roger Tourangeau, 2nd Edition, 2009.
[49]   See, e.g., American Association for Public Opinion Research ("AAPOR") – www.aapor.org; American Statistical Association ("ASA") – www.amstat.org.

EXPERT REPORT OF STEFAN BOEDEKER

81.   Each survey must be designed properly, implemented correctly, and the data obtained through the survey must be analyzed using the appropriate and correct statistical methodology. The proper design of a survey requires the following steps:

    a.   State goal/purpose of survey;

    b.   Define universe;

    c.   Identify sampling frame;

    d.   Determine survey methodology (mail, telephone, internet, etc.) and selection of survey respondents;

    e.   Determine adequate sample size;

    f.   Develop questionnaire/survey questions; and

    g.   Conduct a pre-test/pilot or perform research to obtain information from a sample of consumers about their preferences and which product attributes they perceive as important.

82.   Once the design process has been completed, the chosen design has to be correctly implemented. In this phase the following items have to be considered:

    a.   Approach selected survey respondents.

    b.   Conduct actual interviews.

    c.   Record and tabulate collected data.

83.   Finally, the purpose of each survey is to collect data to answer certain questions, or in more statistical terms, test certain hypotheses. Once the survey has been conducted, it is of utmost importance to prepare the data for further statistical analysis, and then apply the correct statistical methodology to ensure that the survey results are reliable. In particular, the following steps have to be performed:

    a.   Check raw data for errors and inconsistencies;

    b.   Identify erroneous responses;

    c.   Conduct a statistical summary of cleansed raw data;

    d.   Answer questions/test hypotheses; and

    e.   Compile a summary of results and report.

EXPERT REPORT OF STEFAN BOEDEKER

5.2   Surveys/Empirical Studies Using Internet Panels

84.   Current research suggests that the increased use of internet surveys has great advantages over other traditional methods. For instance, studies have found that computer data collection yields higher concurrent validity, with fewer chances of participants framing answers to attempt to please the questioner, and less random measurement error when compared to mall intercept studies and telephone surveys. Internet surveys also allow for broad geographic reach to locations in which surveying via mall intercept or other face-to-face methods would not be feasible.[50] Well-executed internet survey research is regularly accepted by courts.[51]

85.   Unsurprisingly, internet surveys have become a fixture in the corporate world. According to the Global Research Business Network, internet surveys now account for more than a quarter of global market and social research revenues. In many of the world's top research markets, internet surveys are now the primary means of research.[52]

86.   The efficacy of internet-based surveys benefits from large internet panels by specialized market research firms. These firms employ trained professionals who program, administer, and quality control the surveys to increase the quality of the results.

87.   Advanced statistical methods can be applied to compute model-based approximate confidence intervals for well-designed and well-balanced non-probability samples. In 2016, the American Association of Public Opinion Research ("AAPOR") issued a guidance paper on "Reporting Precision for Nonprobability Samples"[53] which details approaches and reporting guidelines when precision calculations are performed for non-probability samples. For the statistical analysis of the data obtained through the Choice Based Conjoint ("CBC") Study, I will apply one of the recommended methods to obtain precision estimates and approximate confidence

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[50]   *See* "Reference Guide on Survey Research," S.S. Diamond, *Reference Manual on Scientific Evidence*, Third Edition, Federal Judicial Center, 2011, Page 401. Additionally, online surveys have advantages in terms of efficiency and cost.

[51]   "Why Online Surveys Can Be a Smart Choice in Intellectual Property Litigation," B. Isaacson et al., IPL Newsletter (ABA Section of Intellectual Property Law) Vol. 26, No. 3, 2008.

[52]   http://fortune.com/2015/09/16/online-survey-companies-law-firms/.

[53]   AAPOR   Guidance   on   Reporting   Precision   for   Nonprobability   Samples   -
https://www.aapor.org/getattachment/Education-Resources/For-Researchers/AAPOR_Guidance_Nonprob_Precision_042216.pdf.aspx.

EXPERT REPORT OF STEFAN BOEDEKER

intervals at the customary 95% level for the results from my study. The bootstrapping methodology and the use of non-parametric percentile based approaches have been endorsed as valid approaches by AAPOR.[54] Furthermore, the aforementioned Sawtooth Software allows for a non-parametric approach to compute confidence intervals.[55]

88.   As described above, the empirical study will include a CBC module which is designed to quantify the value that consumers assign to attributes of smartphones, including a properly functioning microphone. This will be discussed in more detail in Section 6. The attributes will be derived from the pre-test-survey. The conjoint study will be administered via an online panel. We will ensure that the vendor to be selected to conduct the conjoint study will follow accepted standards regarding:

    a.   Survey panelist recruiting;

    b.   Strategic partnerships with other market research firms;

    c.   Use of advanced software and technology;

    d.   Use of proprietary survey completion time tracker;

    e.   High quality filtering system to track respondent information and respondent behavior to deliver the highest quality sample;

    f.   Best practices of quality control - including removal of sign-ups who provide inconsistent demographic information, GeoIP lookups at time of registration and, most importantly, periodic use of mailed survey awards for U.S. panelists to verify street addresses;

    g.   Data tabulation and recording; and,

    h.   Survey participation validation.

89.   As is standard survey practice for surveys used in litigation proceedings, the surveys were conducted in a "double-blind" fashion,[56] that is, neither the vendor nor the respondents should be aware of the survey sponsor or the ultimate intention of the survey. Additionally, the data

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[54]   Ibid.
[55]   See Paragraph 47.
[56]   Diamond, Shari, S. (2012) "Reference Guide on Survey Research," *Reference Manual on Scientific Evidence*, Committee on the Development of the Third Edition of the Reference Manual on Scientific Evidence; Federal Judicial Center; National Research Council, Pages 410-411.

EXPERT REPORT OF STEFAN BOEDEKER

collection and initial tabulation will be automated and concurrent with answering the online questionnaire.

90.   To ensure that the data generated by the survey are of the highest quality, additional quality control measures will be implemented:

   a. Respondents are required to enter their gender and age at the outset of the survey and if these data conflict with the respondent information on file with the online panel operator, the respondent is excluded.
   b. Respondents who indicate that they did not understand or were unwilling to adhere to the survey instructions are also screened out of the survey.
   c. The selected online panel members will receive a link containing an embedded identification number to ensure that only invited respondents can answer the survey and that each respondent can only complete the survey once, and that only one member per household can complete the survey.
   d. The survey also includes a control measure to evaluate the extent to which respondents were involved in completing the survey such as a review of each respondent's survey completion time, review of text field responses, straight-line testing, and other filtering techniques that filter automated responses and result in superior data as well as higher quality feedback.

91.   In summary, properly designed and well-executed internet-based surveys can be used to draw valid statistical inferences about the target population and can provide reliable results and have advantages over other recruiting methodologies. Over the last decade, internet surveys have increasingly gained popularity and acceptance, including in litigation.

92.   In prior conjoint studies I have commissioned a survey company called Amplitude Research ("Amplitude") to program and host surveys and conjoint studies of my design and then provide me with the raw data to analyze the preferences and choices of consumers.

93.   Founded in 2002, Amplitude Research® is one of the leading mail, telephone and online survey companies serving clients throughout the United States, Canada, South America, and Asia. Clients include commercial, educational and governmental organizations. Amplitude Research®

EXPERT REPORT OF STEFAN BOEDEKER

is a member of the American Marketing Association (AMA), Marketing Research Association (MRA), Interactive Marketing Research Organization (IMRO), and Marketing Research Association of South Florida, and adheres to the professional guidelines for survey companies applied by these organizations. Amplitude Research is also A+ Rated by the Better Business Bureau.[57]

94.   For this case, I commissioned Amplitude to conduct a pre-test survey as an internet panel survey. The results of the pre-test survey and how these results will be used in the design of the conjoint study will be discussed below.

5.3 Pre-Test Survey

95.   At the direction of Plaintiffs' counsel, I designed the pre-test survey to gain an understanding of how certain attributes impact preferences and choice behaviors of consumers and how consumers rank the importance of such attributes. Neither the survey respondents nor the survey vendor had any information on the context of the study or who commissioned it, and they were not informed that the data would be used in litigation, or more specifically, in this particular matter. Amplitude conducted the pre-test survey as an online internet survey from October 16 to October 22, 2018.

96.   Using the survey vendor's access to large online consumer panels, I targeted a demographically diverse group of respondents who have been recent purchasers of Android smartphones, including Google phones. When recruiting survey participants, the survey vendor employed a method of balancing the survey participants based on demographics and socio-economic factors such as gender, age, income, and geographical region.

97.   Respondents were only included in the survey if they met the following criteria:

   a.   Respondent is 18 years or older;

   b.   Respondent resides in the United States;

   c.   Respondent has purchased a qualifying smartphone with Android operating system between 2015 and 2018;

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[57]   http://www.amplituderesearch.com/survey-company.shtml.

EXPERT REPORT OF STEFAN BOEDEKER

d.   Respondent is not working in market research.

98.   Amplitude invited panel members based on the screening filters above. After qualifying for the survey, the participants responded to questions designed to elicit their thoughts on smartphones. 500 respondents competed the survey.

99.   **Table 1** shows the demographic distribution of the 500 respondents participating in the pre-test survey. 49.8% of respondents were male and 50.2% were female. Most respondents fall in the age group 45-59 years, closely followed by the age group 60 or older. Most respondents have a household income of $50 to $75 thousand. Most of the respondents have a bachelor's degree or higher.

Table 1   -   Demographics of Pre-Test Survey Participants

Group	Count	Share
Male	249	49.8
Female	251	50.2
18-29	90	18
30-44	130	26
45-59	154	30.8
60 or older	126	25.2
Less than $25,000	86	17.2
$25,000 to $34,999	47	9.4
$35,000 to $49,999	53	10.6
$50,000 to $74,999	108	21.6
$75,000 to $99,999	85	17
$100,000 to $149,999	82	16.4
$150,000 or more	34	6.8
Prefer not to answer	5	1
Midwest	121	24.2
Northeast	115	23
Southeast	105	21
Southwest	49	9.8
West	110	22
Less than high school	8	1.6
High school	88	17.6
Some college	166	33.2
Bachelor's degree or higher	238	47.6

Source: Own analysis based on Amplitude Research pre-test survey

EXPERT REPORT OF STEFAN BOEDEKER

100.   Figure 8 shows the geographic distribution of the survey participants relative to the overall population in the United States. The geographic distribution of survey participants matches relatively closely the distribution of the overall population in the continental United States. I did not include participants from Puerto Rico in the survey and do not include Puerto Rico in the overall population on the right.

Figure 8   *Respondents and US Population by Region*


Source: Pre-Test/Pilot Study.

101.   Figure 9 shows the smartphone brands purchased by participants over the past three years. Participants could name multiple brands if they had purchased more than one smartphone. Samsung has a share of 52%%, followed by LG (18%), while 34 respondents (5.3%) said that they owned Google smartphones.

EXPERT REPORT OF STEFAN BOEDEKER

Figure 9   *Smartphone Brands Purchased by Participants in the Pre-Test Study*
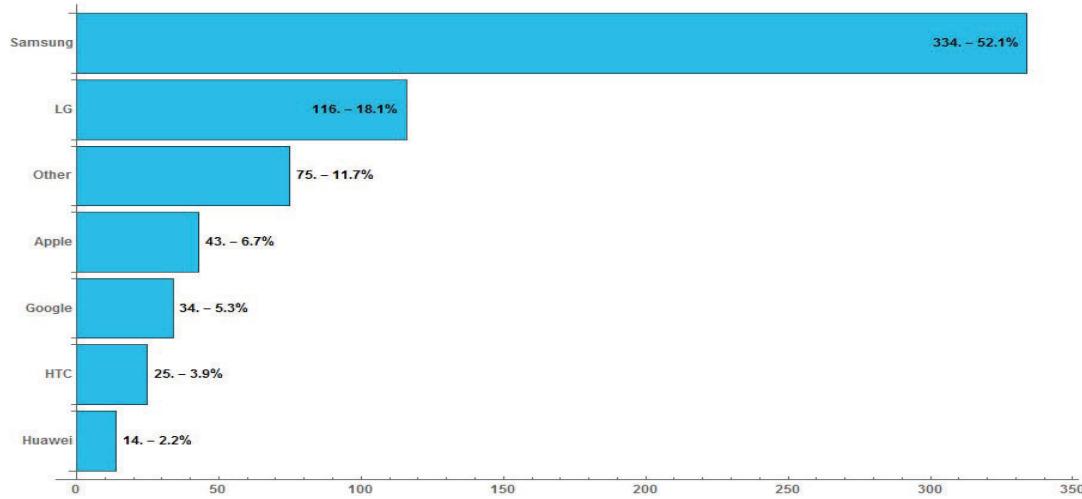
Source: Pre-Test/Pilot Study.

102.   In Figure 10 I show for the respondents who owned a Google smartphone which Google model they purchased most recently. The Pixel 2 is the most prevalent (41%), followed by the Pixel 2 XL (18%) and the original Pixel (18%).

Figure 10   *Google Smartphone Models Owned by Survey Respondents*
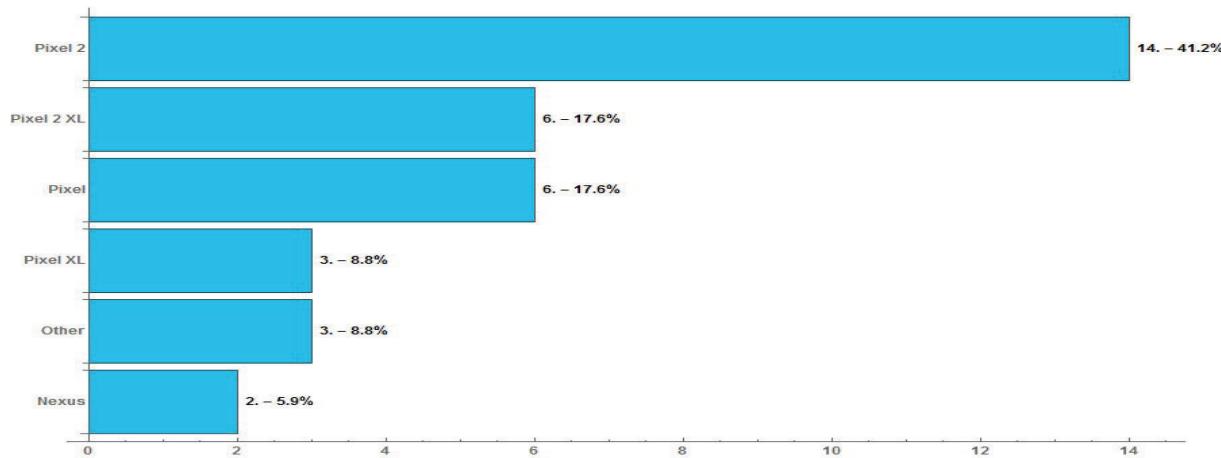
Source: Pre-Test/Pilot Study.

103.   36% of participants had bought their most recent smartphone in 2018 and 41% had bought their most recent smartphone in 2017.

EXPERT REPORT OF STEFAN BOEDEKER

Figure 11   Year When Participants Bought Their Most Recent Smartphone
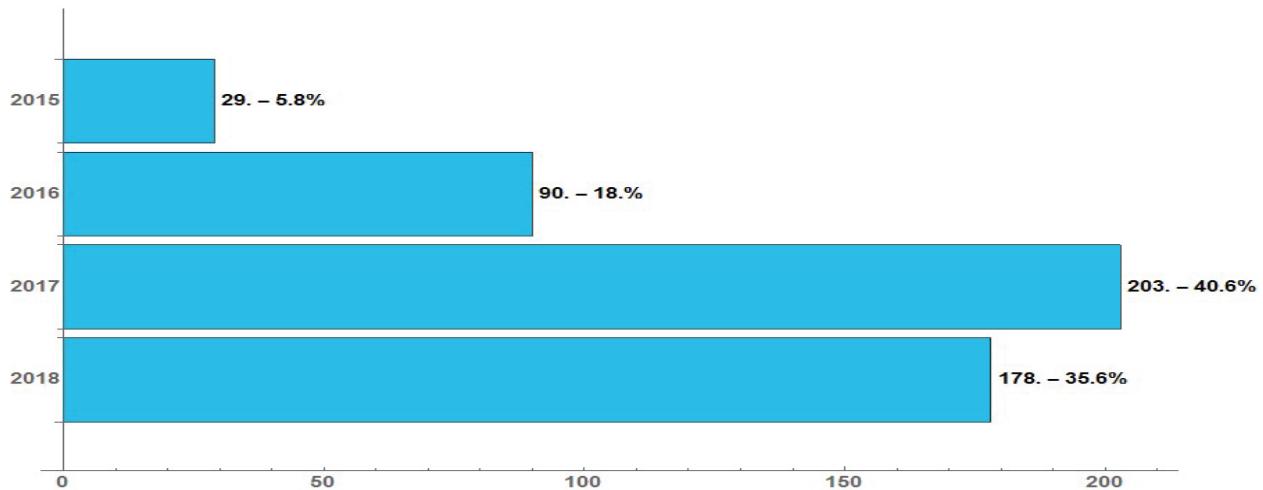
Source: Pre-Test/Pilot Study.

104.   Figure 12 shows the share of respondents who had purchased their smartphones for personal and business use. Most respondents (78%) use their smartphone for personal, non-commercial use.

Figure 12   Personal vs. Business Use

Source: Pre-Test/Pilot Study.

EXPERT REPORT OF STEFAN BOEDEKER
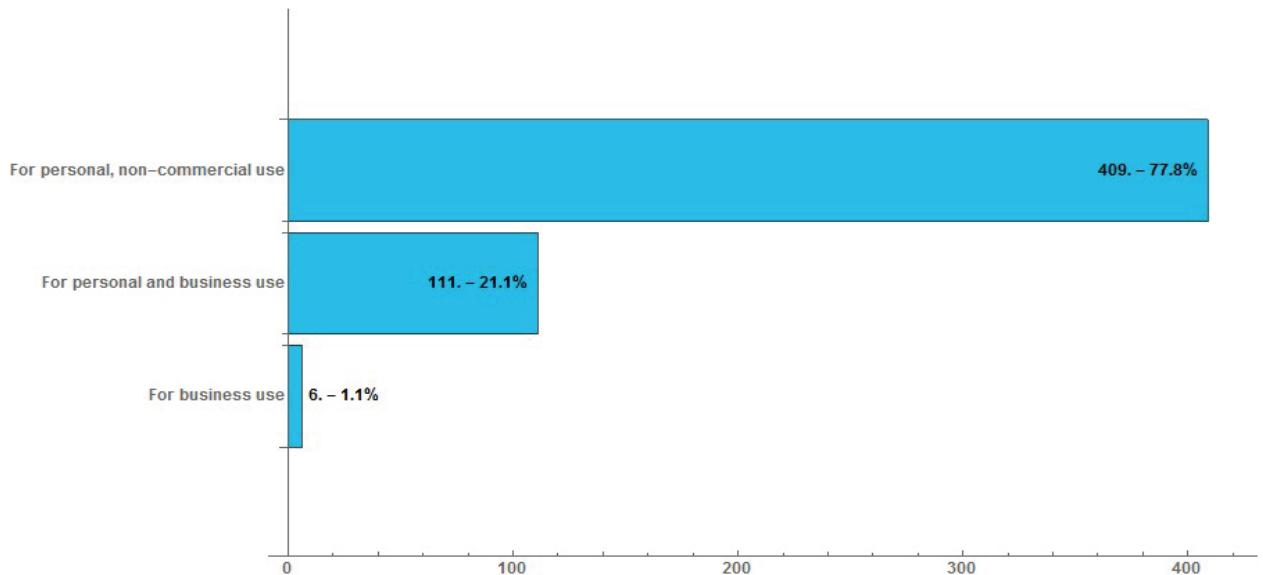
105.   Consumers have various options how to purchase or finance their mobile phones. Historically, many consumers received their phone free or at a discounted price but entered a long-term contract with their service provider, who then recouped the cost of the mobile phone in the course of the service contract. Increasingly, service providers limit the subsidies they are providing, and consumers purchase more and more at full price or through some promotion or sale. Figure 13 shows the responses to the question how respondents financed their most recent smartphone. The majority (55%) had purchased the smartphone at full price. 19% had received some discount due to a trade-in.

Figure 13   *Financial Aspect of Most Recent Smartphone Purchase*
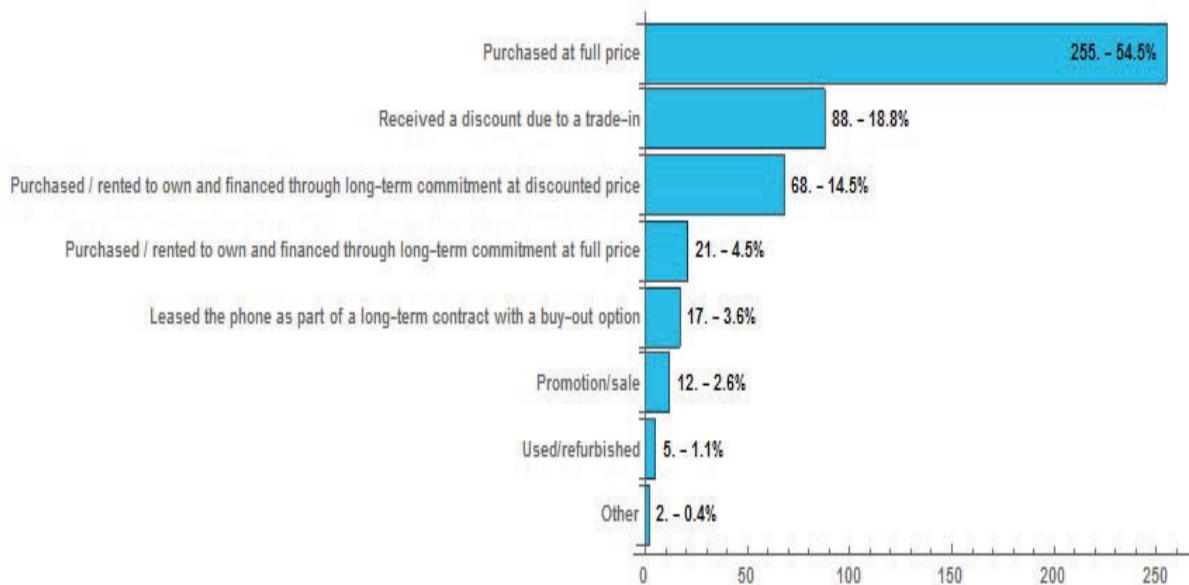
Source: Pre-Test/Pilot Study.

106.   Respondents were asked to select which attributes were important to them. Multiple selections were possible. The question also included an "Other" category. Respondents who selected "Other" then could respond to an open-ended question and name additional categories. Figure 14 summarizes the answers to the question, which attributes respondents value when purchasing a smartphone. The attribute "Price" receives most mentions (12%), followed by battery life (11%) and reliability (10%). I did not include the quality of the microphone or audio as the purpose of this question was to determine the ranking of attributes that would appeal to Android phone owners in general and the attributes had to be suitable to be used in a conjoint survey.

EXPERT REPORT OF STEFAN BOEDEKER

Figure 14   Smartphone-Attributes Chosen by Respondents
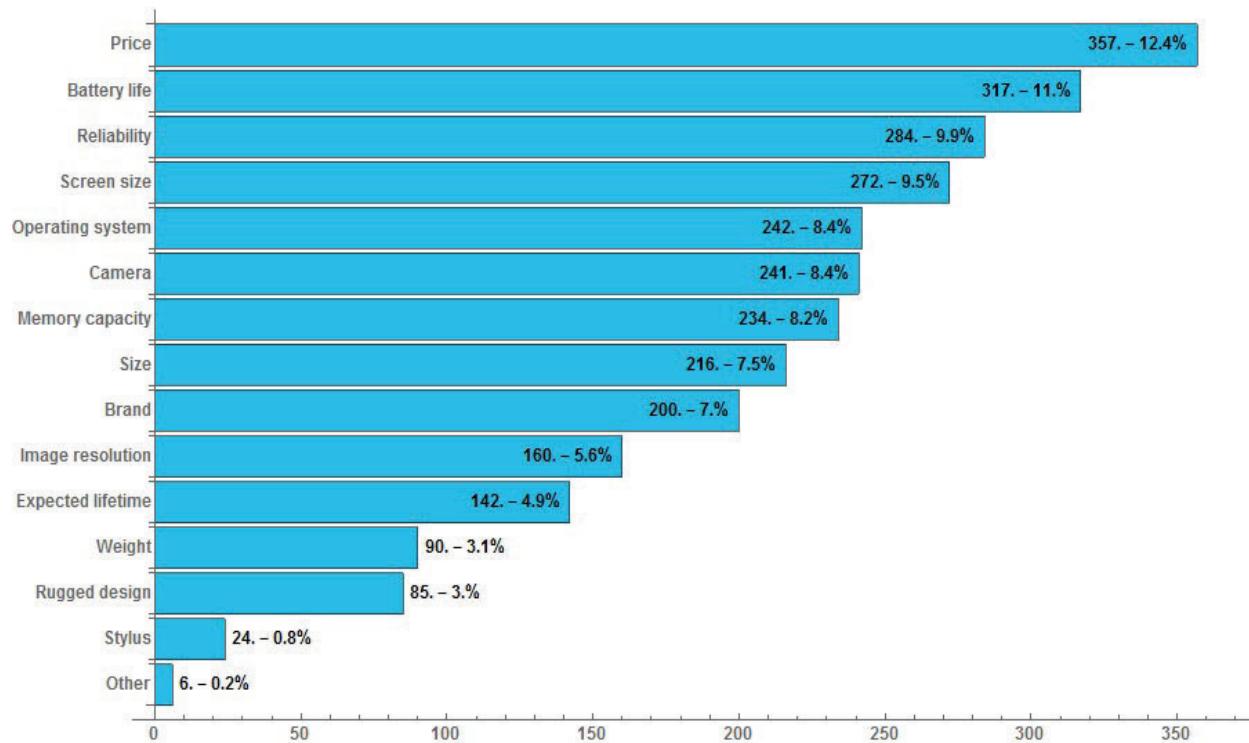
Source: Pre-Test/Pilot Study.

107.   Respondents were then asked to assign weights to each of the attributes they had listed in response to the previous question. Figure 15 summarizes the results. Price remains the most important weighted attribute – on average respondents assign a weight of 18 out of 100 points to this attribute, followed by battery life, brand and reliability.

EXPERT REPORT OF STEFAN BOEDEKER

Figure 15   ***Weighted Importance of Smartphone-Attributes***
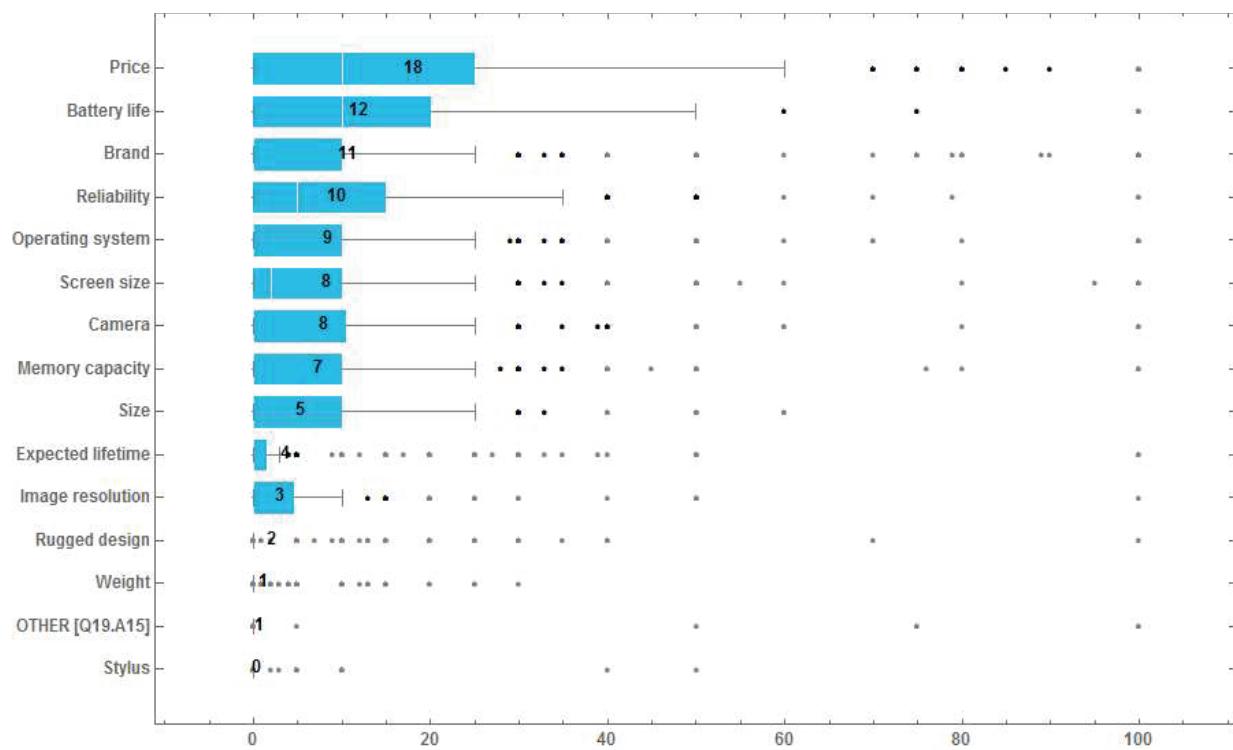
Source: Pre-Test/Pilot Study.

108.   I also applied two statistical tests to determine whether owners of Google phones responded differently (i.e., placed significantly different values on different attributes) than respondents who owned other Android phones. I applied the Kolmogorov-Smirnov ("KS")[58] test to determine whether the weights Google phone owners attributed to each attribute were drawn from the same distribution as the weights that respondents who did not own a Google smartphone had assigned to the respective attributes. Table 2 shows the test results. The KS test rejects that the weights were drawn from the same distribution for two out of 15 attributes. Two attributes were mentioned by only one respondent with a Google smartphone, which means that the KS test will be inconclusive. I also applied a two-sided T-test,[59] which tests whether the means for both sub-populations are statistically similar. This test rejects the hypothesis that the means for the two sub-populations are different in all cases but for the attribute Price.

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[58]   Corder, G. W.; Foreman, D. I. (2014). Nonparametric Statistics: A Step-by-Step Approach. Wiley, pages 80-83.
[59]   John A. Rice (2006), Mathematical Statistics and Data Analysis, Third Edition, Duxbury Advanced

EXPERT REPORT OF STEFAN BOEDEKER

Table 2   *Statistical Tests on Differences Between Owners of Google Phones and Owners of Other Android Phones*

Attribute	Mentioned by Participants			Mean Weight Attributed by Participants			Kolmogorov-Smirnov Test			Two-Sided T-Test		
	All	Pixel	Others	All	Pixel	Others	Coefficient	P-Value	Conclusion	Coefficient	P-Value	Conclusion
Price	338	15	323	18.1	9.6	18.7	0.252	0.0154	Reject	-3.3601	0.0016	Reject
Battery life	310	16	294	12	13.1	11.9	0.1603	0.1944	Do not reject	0.4436	0.6576	Do not reject
Brand	196	14	182	10.8	16	10.4	0.1099	0.3822	Do not reject	1.5113	0.1313	Do not reject
Reliability	269	14	255	9.6	7.2	9.7	0.1563	0.1856	Do not reject	-1.0481	0.2951	Do not reject
Operating system	227	17	210	8.5	11.1	8.3	0.1372	0.2498	Do not reject	1.0009	0.3232	Do not reject
Screen size	258	11	247	8.4	5	8.6	0.2065	0.0495	Reject	-1.9302	0.0601	Do not reject
Camera	234	16	218	8.1	9.8	8	0.1169	0.362	Do not reject	0.8128	0.4167	Do not reject
Memory capacity	228	12	216	7.5	4.8	7.7	0.1106	0.4112	Do not reject	-1.3349	0.1825	Do not reject
Size	208	14	194	5.4	7.2	5.3	0.0718	0.742	Do not reject	1.1441	0.2531	Do not reject
Expected lifetime	128	9	119	3.7	4.3	3.6	0.0309	0.9881	Do not reject	0.3674	0.7135	Do not reject
Image resolution	138	9	129	3.1	5.4	3	0.0417	0.9411	Do not reject	1.7201	0.086	Do not reject
Rugged design	81	6	75	2.2	2.1	2.2	0.0505	0.6725	Do not reject	-0.1082	0.9139	Do not reject
Weight	82	6	76	1.3	2.2	1.3	0.0567	0.5462	Do not reject	1.3885	0.1656	Do not reject
OTHER [Q19.A15]	6	1	5	0.8	2.2	0.7	0.023	0.2496	Do not reject	1.0299	0.3036	Do not reject
Stylus	19	1	18	0.4	0.1	0.5	0.0236	0.8125	Do not reject	-0.5357	0.5924	Do not reject

Source: Pre-Test/Pilot Study.

109.   Attributes to include in a conjoint study need to be objectively measurable and need to be of relevance to respondents. The top attribute "Price" is the attribute required to determine the economic value of the attributes and it therefore has to be included in any conjoint survey. Brand ranked third for survey respondents. Due to the limited market share of the Pixel, the conjoint survey will need to include respondents that own other brands and therefore brand could be an important variable. However, in order to keep respondents in the dark about the purpose of the study I will instruct them to assume that they have settled on the phone and brand and that they only choose from additional available options. Therefore, brand is not one of the attributes I plan on varying in the survey. Reliability ranks fourth but is hard to measure objectively because it summarizes many other different attributes. Therefore, it is not recommended to include this attribute in the conjoint survey. The operating system ranks fifths but because the survey participants are drawn from the population of Android users, there is no variation across participants and therefore I plan on not including this attribute. Based on the results of the Pre-Test Survey, I selected the following attributes for the Conjoint Survey in addition to Price and the description of the defect:

EXPERT REPORT OF STEFAN BOEDEKER

a. Battery life, ranked second;

b. Screen size, ranked sixth;

c. Camera resolution, ranked seventh;

d. Memory capacity ranked eighth.

6   Proposed Choice Based Conjoint Study

110.   In this section, I will explain in detail how the results from the pre-test will be utilized to design the CBC empirical study. The following paragraphs outline a draft conjoint study:

111.   The participants will be introduced to the conjoint menu section of the empirical study by a brief description of a purchase situation similar to the below:

"Next, we will ask you a series of questions about your preferences for smartphones. For this exercise, please assume that you are planning to buy a smartphone. You have already settled on the design and brand and you have chosen a model for $700. You intend to buy this phone at the retail price. The model for $700 has the following features:

a. *Battery life measured in talk time of 26h*

b. *A screen size of 5.66 x 2.74 inches*

c. *A back camera resolution of 12.3 megapixels with built in gyroscope for image stabilization, and*

d. *A storage capacity of 64 GB.*

On the following screens you are offered an incremental package at an incremental price.

The incremental options you can choose from are as follows:

a. *Talk time of 20h, 26h, 30h;*

b. *Screen size of 5-inch (130 mm) AMOLED display panel with 1920×1080 resolution/6-inch (150 mm) P-OLED display panel with 2880×1440 resolution;*

EXPERT REPORT OF STEFAN BOEDEKER

       c.   12.2 megapixel rear camera capable of recording 4K video at 30 FPS/18 megapixel rear camera capable of recording 4K video at 60 FPS;

       d.   Storage options of 64/128 GB.

In addition to these additional option packages, the sales person also discloses to you that there are inherent problems with the phone's audio that can occur during regular use of the smartphone: Accordingly, when the audio defect manifests with a certain probability, the user cannot make or receive phone calls without headphones, use the speakers, or use the voice-activated assistant feature.

You will be presented with 12 choice menus that contain information about the incremental attributes of the smartphone and a dollar amount that represents that represents the price you are willing to pay for the smartphone described in that option depending on how you value the additional choices for each attribute. Please select the combination of attributes and price that is most attractive to you. Once you select your most attractive option, you will be asked to confirm that you would purchase option. If none of the presented options appears attractive to you, you can select "None – I would not buy any of these."

There are no correct or incorrect answers in this exercise. We are just interested in your opinion."

112.   Figure 16 shows an illustrative example of a conjoint choice menu. As can be seen, each choice set consists of five choices with various combinations of product attributes and prices, as described above, and sequenced differently in different choice sets. After respondents choose their preferred option, they answer the question of whether they would actually purchase that preferred option. Each participant will go through several such screens. Each screen shows randomly selected levels for each attribute. Therefore, Figure 16 does not necessarily show all levels for each attribute.

EXPERT REPORT OF STEFAN BOEDEKER

Figure 16: Example of a CBC Choice Menu

	Option 1	Option 2	Option 3	Option 4	Option 5
Talk time	Yes	No	Yes	No	No
Screen size	*5-inch (130 mm) AMOLED display panel with 1920×1080 resolution*	*6-inch (150 mm) P-OLED display panel with 2880×1440 resolution*	*5-inch (130 mm) AMOLED display panel with 1920×1080 resolution*	*6-inch (150 mm) P-OLED display panel with 2880×1440 resolution*	*No5-inch (130 mm) AMOLED display panel with 1920×1080 resolution*
Camera	*18 megapixel rear camera capable of recording 4K video at 60 FPS*	*12.2 megapixel rear camera capable of recording 4K video at 30 FPS*	*18 megapixel rear camera capable of recording 4K video at 60 FPS*	*12.2 megapixel rear camera capable of recording 4K video at 30 FPS*	*18 megapixel rear camera capable of recording 4K video at 60 FPS*
Memory capacity	64	128	128	64	64
User cannot make or receive phone calls without headphones, use the speakers, or use the voice-activated assistant feature	■ in 100 chance of at least one of these defects	4.4 in 100 chance of at least one of these defects	No defect	9.2 in 100 chance of at least one of these defects	No defect
Price	$550	$950	$750	$650	$850
Which option would you prefer?	☐	☐	☐	☐	☐

Source: Illustrative Example.

113.   Once the participant has chosen an option, they will be prompted one more time if the chosen option is the one they would buy.

114.   The prices in the CBC Choice Menu in Figure 16 are the prices for the smartphone that the respondents were asked to assume in the description of the conjoint exercise. These prices are not necessarily prices for a smartphone that one would observe in in the market. However, three considerations determined the prices chosen for the study:

    a. Generally, the price range should cover realistic prices for the product. For example, a price of $100 for a smartphone would not be realistic as the typical retail price is higher. Similarly, a price of $2,000 would also not be realistic because it is much higher than the typical retail price.

    b. Prices also can be slightly higher or lower than the prices of currently offered products as we test product attribute combinations that might not actually be available in the market.

    c. In the context of this litigation it is necessary to determine the demand for Pixel Phones had it been disclosed at or before the point of purchase or during the applicable remorse period[60] that the Pixel Phone has the Defect with a certain probability of manifestation. As Google did not disclose the Defect to its customers, there is no actual market price available for the but-for world. Hence, in order to estimate a demand curve for the Pixel Phones for which the Defect would be disclosed at the point of purchase, both prices below and above the price points common in the market have to be included.

115.   In my opinion, the price range from $550 to $950 conforms with these considerations.

This opinion is based on review of retail prices for several smartphones offered by Google (Figure 17) which shows that the overall median price of the Pixel is $800[61].

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[60]   Deposition of Steven James at 95:3-15 ███████████████████████████████████████ ; https://support.google.com/store/answer/2411741?hl=en;   https://www.verizonwireless.com/one-support/return-policy/.

[61]   The retail prices do not include prices for the Google Pixel which is the less expensive model. Therefore, the medium price lower than $800. The mid-point of the chosen price range of $550 to $950 for the conjoint study is $750.

EXPERT REPORT OF STEFAN BOEDEKER

Figure 17: Selected Pixels and Their Retail List Prices

Model (Name)	Internal Memory (GB)	4G LTE	Price (One Time Payment)	Screen Size
Pixel 2[1]	64	No	$649.99	5
Pixel 2[1]	128	No	$749.99	5
Pixel 2 XL[1]	64	No	$849.99	6
Pixel 2 XL[2]	64	No	$849.99	6.3
Pixel 2 XL[1]	128	No	$949.99	6
Pixel 2 XL[2]	128	No	$949.99	6.3
Pixel 3[1]	64	Yes	$799.99	5.5
Pixel 3[2]	64	Yes	$799.99	5.5
Pixel 3[1]	128	Yes	$899.99	5.5
Pixel 3[2]	128	Yes	$899.99	5.5
Pixel 3 XL[1]	64	Yes	$899.99	6.3
Pixel 3 XL[2]	64	Yes	$929.99	6.3
Pixel 3 XL[1]	128	Yes	$949.99	6.3
Pixel 3 XL[2]	128	Yes	$1,029.99	6.3

Source:
[1] Price Retrieved from Bestbuy.com

[2] Price Retrieved from Verizonwireless.com

116.   The CBC employed in the survey randomly assigned choices from all possible choices[62] with equal likelihood and with uniform frequency of each level of each attribute and each pair of attribute/level permutations. That is, the CBC design is *balanced* and *orthogonal*. Balanced and orthogonal surveys are commonly employed in CBC.[63] The importance of an orthogonal and balanced design lies in the fact that designs of this type are 100% efficient. Efficiency implies that the resulting estimations have the smallest mean squared error out of all possible designs.[64] The mean squared error measures the level of variation and, as such, the precision of the resulting estimates. The smaller the mean squared error of an estimate the more precise it is. As such,

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[62]   There are 2 levels for three attribute, 3 levels for one and five levels for price. This yields 2x2x2x3x5 (or 120) different possibilities of combining the different levels of the attributes in the study.

[63]   Bakken, David & Curtis L Frazier, "Conjoint Analysis: Understanding Consumer Decision Making," in Grover, Rajiv & Marco Vriens, eds., The Handbook of Marketing Research, Thousand Oaks: Sage Publications, Inc., 2006, Chapter 15.

[64]   The mean squared error (MSE) is calculated as the average of the squared distances between the estimator and what is estimated, or the "errors." Efficient designs are ones that minimize the MSE.

EXPERT REPORT OF STEFAN BOEDEKER

efficiency of a design is a measure of the information content of a design. Therefore, more efficient designs imply more reliable results.[65]

117.   It is a known phenomenon that choices presented earlier in a list of choices in a questionnaire are disproportionately likely to be selected.[66] This phenomenon is known as order bias. To avoid order bias in the conjoint menus, the attributes and their respective levels will be shown in a different order, chosen at random, to each respondent – except for price, which is always shown last. The reason for showing price last lies in the fact that the respondents have to see the attributes of the product first to be able to decide for or against the purchase of a particular option.

7   Economic Loss Calculation

7.1   Four-Step Estimation Process

118.   As described above, a CBC study will be utilized to assess if giving consumers the information at the point of purchase that Pixelshave the Defect with a certain probability as alleged by Plaintiffs would lead to a downward shift of the demand curve for Pixels and if that is true by how much the demand will shift downwards.

119.   The following four-step estimation process to determine the economic loss associated with purchasing a Smartphone that has the Defect:

   a.   Step 1: Based on the results from the CBC analysis, compute individual part-worths estimates for each respondent for each attribute and each level in the study that will be utilized to compute the probability that consumers purchase a specific bundle of attribute levels.

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[65]   The standard error is the standard deviation of the sampling distribution of a statistic. A smaller standard error implies a smaller margin of error, which results in a tighter confidence interval around an estimate.

[66]   Krosnick, Jon and Duane Alwin, "An evaluation of a cognitive theory of response order effects in survey measurement," Oxford Journals Social Sciences Public Opinion Quarterly Volume 51, Issue 2, Pages. 201-219.

EXPERT REPORT OF STEFAN BOEDEKER

b. Step 2: Construct the demand curves for the product in the actual world (i.e., the Defect is not known to the consumer at the point of purchase) and the but-for-world (i.e., the Defect is now known to the consumer at the point of purchase).

c. Step 3: Test if consumer demand shifts downward when the consumer knows about the Defect at the point of purchase, and quantify the drop, if the tests show a downward shift of the demand curve.

d. Step 4: Conduct market simulations to assess the economic loss associated with the drop in demand when the consumers know about the Defect at the point of purchase.

120.   In Step 1, I plan to utilize a software program called Sawtooth[67] to compute part-worths for the attributes and the levels for each attribute in the study. The Sawtooth software applies the Hierarchical Bayesian Estimation technique explained above to compute individual part-worths for each respondent and aggregate part-worths for all levels and attributes in the study. The Sawtooth software allows the researcher to test different model specifications. For example, Sawtooth allows to implement the constraint that each respondent will always prefer lower to higher prices.

121.   This so-called monotonicity constraint refers to a property of the part-worths estimates. Without the monotonicity constraint, the individual part-worth estimates may yield higher numerical values for levels that seem to be lower in utility for some individuals, and thus seemingly indicate "illogical" consumer choices.

122.   However, this behavior can be explained by the fact that the "rational economic consumer" is only a postulate or an assumption in theoretical economics while in the "real" world not all variables affecting consumer choices can be measured, and therefore, consumers often do exhibit seemingly irrational behavior. For example, I may stop at a gas station that charges $0.20 more per gallon because I am already running late on my way to work and this particular gas station is

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[67]   Sawtooth software is a world leader in market research for conjoint analysis providing powerful tools for measuring how consumers value features of a product or service. For more information, see www.sawtoothsoftware.com/

EXPERT REPORT OF STEFAN BOEDEKER

the one, I can get to easily without detour. While it may seem irrational to pay more for gas, the convenience factor in this example cannot be measured and quantified.

123.   The Sawtooth software allows the researcher to "smoothen" the part-worth estimates in a way that higher price levels for a specific attribute combination are always associated with a lower part-worth value. This feature ensures that not only aggregated consumer choices, but also individual consumer choices are always associated with decreasing utility values for increasing prices. When using a monotonicity constraint, the demand curves are smoother, and therefore, the resulting market simulations have fewer extreme data points making the damages estimates on average lower.

124.   In Step 2, the part-worth estimates will be applied to construct the demand curve for the product when the Defect is not disclosed to the consumer at or before the point of purchase. Further, I construct the demand curves for the other levels for an attribute of interest.

125.   In Step 3, I quantify the drop in consumer demand and – all else equal – the new price consumers would pay after the disclosure of the Defect at or before the point of purchase. Based on the extent of the downward shift of the demand curve, I can then calculate economic damages to the members of the putative class based on their purchase of the product with the undisclosed Defect.

126.   In Step 4, I conduct market simulations to assess the economic loss associated with the drop in demand after the disclosure of the Defect at the point of purchase that will be utilized in the quantification of class-wide economic losses.

7.2   Market Simulations in Conjoint Analyses

127.   To assess the robustness of the demand curve estimation under a variety of market conditions, I will perform a comprehensive market simulation study using the individual part-worths which will be estimated from the conjoint study using the Hierarchical Bayesian Estimation methodology. In my market simulations, I will use all variations of the attributes and levels defined in the conjoint study.

128.   Market simulations are an important tool to convert the part-worths from the conjoint study into monetary measures reflecting consumer preferences and choices. Part-worths estimates per se

48

EXPERT REPORT OF STEFAN BOEDEKER

do not reflect monetary values. Rather, they quantify respondents' preferences for each level of each attribute. These part-worths can be analyzed to assess how the respondents react to changes in the product attributes at different price points. Ultimately, the choice probabilities are used to construct demand curves which relate price and quantity. A comparison of the demand curve for the scenario where the Imperfections are not known to the consumers at the point of purchase and the demand curve for the scenario where the Imperfections are known to the consumers at the point of purchase will reveal if a drop in the demand curve has occurred, and if so, the degree of the drop in demand then quantifies the economic loss

129.   Further tests will be utilized to quantify if and how changes in an attribute will affect the value that consumers put on that attribute (e.g., in general, different permutations of product attributes and levels of those product attributes are applied in a market simulation to assess the respondents' choice probabilities for different combinations of product attributes and the resulting economic loss.

130.   The market simulation consolidates the preferences and choices for all respondents which enables us to answer questions about preference and likelihood of choice when attributes and levels of product attributes are changed.

131.   By using the individual part-worths, it is possible to determine the demand curve for any specific combination of product attributes and their levels for different price points. When the question needs to be answered if and how the change in the level of a particular attribute changes the demand curve then two demand curves can be calculated – the first one for a specific set of levels and attributes and a given price and the second one where the product attributes and price are identical but one level of one attribute is different.

132.   The measured shift in the demand curve, if any, can then be attributed to the changed level. Based on the difference in demand curves, if any was found, it is then possible to determine the change in price that would be necessary to reach the same demand for the product where a level in one of the attributes was changed.

133.   Market simulations can then be applied to determine the economic loss under various scenarios. To be clear, the economic loss derived from the market simulations is *not* an average

value that would be different for all class members – rather, it is the difference in estimated market demand based on consumers' responses to varying choice menus in the Conjoint Analysis designed to derive one numerical figure to quantify the loss in value due to the undisclosed Defect. The choice menu as exemplified in Figure 16 contains an attribute manifesting the likelihood of manifestation which allows for the quantification of economic losses as a function of the manifestation rate. Once the exact manifestation rate is known, class-wide damages can be calculated utilizing this information rather than assuming that the Defect manifests with certainty. The interpretation of this figure is the amount consumers overpaid when purchasing Pixel Phones without knowing about the Defect compared to the amount they would have paid if the Defect manifesting itself with a certain probability had been known to them at the point of purchase.

8   Summary and Conclusion

134.   I conclude that – like in other cases accepted by courts[68] - the conjoint analysis proposed and described in this report can empirically measure what respondents would have paid for the Pixels that don't have the Defect compared to an otherwise identical Pixel that has the Defect with a manifestation rate that is greater than 0% across all Pixels sold without assuming that the Defect manifests itself with certainty. This value can be used to determine if purchasers suffered an economic loss and, if so, to calculate the economic damages if the Court decides to move forward with such an analysis. In essence, the theoretical model proposed in this report measures the difference between the price paid and the price paid if customers had been told at the time and point of purchase about the Defect. Sometimes this difference is also referred to as a price premium.

135.   The method proposed in this report utilizes a theoretical economic model that is based on microeconomic principles that show how the demand for a product changes when attributes and levels of attributes for that product change. To quantify the change in demand when the attributes of the product change (e.g., when previously concealed Defect will be disclosed at the point of purchase), it is possible to design a choice-based conjoint study that elicits survey respondents to reveal their preferences for products with and without the Defect as described to respondents.

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[68]   See for example *Broomfield v. Craft Brew Alliance, Inc.*; *In re MyFord Touch Consumer Litig.*; *Davidson v. Apple, Inc.*; *In re Dial Complete Mktg. & Sales Prac. Litig.*

EXPERT REPORT OF STEFAN BOEDEKER

136.   Further, I conclude that the method proposed and described in this report can be used to expand the results of the conjoint study to a complete model to calculate class-wide damages in the merits phase of this case by multiplying the percentage economic loss per unit as established above with the price and number of units purchased by class members during the class period taking into account the different screen sizes, memory capacities and prices paid by class members. The computation of economic losses as a percentage of the purchase price has the notable advantage that variations in the purchase price for different model specifications like size, capacity, and how the phone was purchased, do not prevent the calculation of class-wide damages because any such variations are captured in the sales data, once they become available.

137.   Lastly, I conclude that the model described in this report to compute class-wide economic losses can be expanded in the merits phase of this case to incorporate additional aspects based on relevant developments in the case. For example, economic loss calculations can be performed on a class-wide basis but also across different geographies (e.g., specific states) or for different time periods by obtaining the specific sales data for such geographies and time periods.

138.   The analysis and opinions contained in this declaration are based on information available as of the date of this declaration. I reserve the right to supplement or amend this declaration in the event additional information becomes available.

139.   I declare under penalty of perjury under the laws of the United States that the foregoing is true and correct. Executed this 5th day of November 2018, at Los Angeles, CA.

_____
Stefan Boedeker
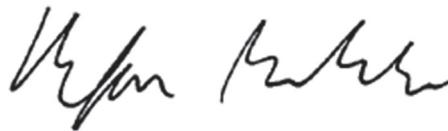
EXPERT REPORT OF STEFAN BOEDEKER

EXHIBIT A

BRG
Berkeley Research Group

STEFAN BOEDEKER

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Berkeley Research Group

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Education

- BS in Statistics,
  University of Dortmund, Germany
- BA in Business Administration
  University of Dortmund, Germany
- MS in Statistics
  University of Dortmund, Germany
- MA in Economics
  University of California, San Diego
- Met Ph.D. requirements except dissertation in Economics,
  University of California, San Diego

Professional Associations

- Member of the American Economic Association (AEA)
- Member of the American Statistical Association (ASA)
- Member of the Econometric Society
- Member of the Mathematical Association of America (MAA)
- Member of the American Association for Public Opinion Research (AAPOR)
- Member of the Insights Association (FKA MRA)
- In 2001 Stefan was a member of an AICPA task force dealing with Corporate Integrity Agreements (CIA). Stefan was responsible for issues related to statistical methodology utilized in CIA's.

Background

Stefan is a Managing Director at Berkeley Research Group where he focuses on the application of economic, statistical, and financial models to a variety of areas such as solutions to business issues, complex litigation cases, and economic impact studies. He has extensive experience applying economic and statistical theories and methodologies to a wide variety of cases where But-for-scenarios have to be developed based on probabilistic methods and where statistical predictive modeling has to be applied to assess liability and damages.

Stefan has applied these techniques in business disputes, single-plaintiff cases, multi-plaintiff cases, and class action proceedings in the areas of class certification, liability assessment, developing damages scenarios, and post settlement or judgment distributions.

Professional and Business Experience

Representative Engagements

Litigation

» In a class action alleging misleading advertising practices, Stefan performed statistical analyses in the class certification stage.

» For a major healthcare provider involved in a dispute with a potential class of more than 3,000 other providers over allegedly excessive outlier payments Stefan performed economic and statistical analyses. Ultimately, class certification was denied in that case.

» In a class action alleging discriminatory allocation of public funds by a large metropolitan transportation authority, Stefan performed statistical analyses of transportation data.

» In a multi-plaintiff case against a state authority on improper funding of special education programs, Stefan performed statistical analyses of funding related ledger data.

» In a class action alleging improper practices of charges for gym memberships, Stefan performed statistical analyses in the class certification analysis. Based on the analysis, the ultimately certified class was significant smaller than initially defined. In this case, Stefan also developed statistical models to assess damages.

» In a class action alleging losses to consumers due to faulty window regulators in automobiles, Stefan utilized statistical models to assess economic damages.

» In a class action against a large financial institution alleging fee overcharges for personal trust accounts, Stefan utilized statistical analyses to segment the account holders and ultimately reduce the size of the class.

» In a class action case where a provider of a used car evaluation model was ordered by the court to test if their model did not significantly undervalued cars, Stefan performed statistical analyses.

» In a class action case over fee overcharges in the payment process of car insurance, Stefan developed a distribution model of repayments to class members after a settlement had been reached.

» In a class action of home owners over alleged diminution of property values due to proximity to a plume of contaminated soil, Stefan performed statistical analysis to assist counsel in a motion against class certification.

» In a natural resource damage class action case, Stefan provided econometric analysis of property value loss due to proximity to a solid waste site utilizing hedonic regression models.

» For a class action case involving potential damage from a landfill in a state park, Stefan analyzed data about travel, tourism and park attendance. Stefan specified and estimated linear regression models and time series models to predict park attendance.

» In a class action case involving alleged diminution of property values due to ground-water contamination, Stefan specified and estimated hedonic regression models to show that other factors than the contamination contributed significantly to the loss in property value.

» In a class action against a large financial institution alleging non-payment of coupon payments for bearer bonds Stefan designed and administered large-scale databases to reconstruct accounting records of a large financial institution's Corporate Trust Department. He developed statistical models to analyze bondholders' presentment behavior of Bearer bonds.

» In a class action dispute between the Department of Interior and individual Native Americans over mismanagement of individual trust accounts, Stefan performed a statistical analysis of an electronic database with approximately 60 million records in order to draw a statistically valid sample of accounts for further analysis.

» In a trademark infringement case of video equipment, Stefan calculated damages based on the defendant's unjust enrichment utilizing statistical time trend models.

» For a shareholder derivative action against a leading publicly-traded health care provider, employed an econometric approach to quantify potential damages per share due to alleged section 10b-5 violations and other claims. For the same matter, developed a multi-trader model to estimate the number of shares potentially damaged.

» In a dispute between a major health care provider and private payor groups, Stefan developed statistical stratified sampling models to assess exposure across different contract types.

» For a large financial institution's personal trust department involved in a consumer class action, Stefan designed a random sample to estimate the potential exposure due to fee overcharges.

» For a computer equipment leasing company involved in an employee class action, Stefan utilized statistical models to estimate exposure due to alleged forfeiture of unpaid vacation time in a class action of former and current employees.

» For a limousine company involved in a wage and hour class action, Stefan developed a statistical sampling based exposure model to quantify the impact of alleged unpaid overtime and missed meal breaks.

» In several cases involving 12 hour shift workers at hospitals Stefan performed rebuttal analyses of plaintiff's damages computations.

» For a large electronic retail chain Stefan calculated exposure based on the failure of paying overtime for store managers.

» For a major department store Stefan performed a statistical analysis of manager surveys where he found significant differences in the managers' allocation of time across department and stores. Ultimately, due to these differences a class was not certified.

» For a large sporting goods retail chain Stefan assisted in defining the size of the potential class and in estimating the potential exposure which led to a favorable, early settlement of the case.

» For a women's shoes retail chain Stefan designed and statistically analyzed an observational study to quantify the amount of time spent on exempt versus non-exempt tasks.

» For a video rental store chain Stefan developed sampling algorithms based on in-store security cameras to analyze time spent by assistant managers on exempt versus non-exempt activities.

» For a large fast food chain Stefan directed a team collecting employee work information from restaurant locations in order to monitor and gain compliance in response to litigation

» For a large mass merchandiser Stefan developed a document and data reconciliation tool and he developed a statistical sampling mechanism to proof compliance with a court ordered document retention procedures in the course of a wage and hour litigation.

» Stefan worked with a Fortune 500 bank in a class action suit to review the claims of managers that were misclassified and should have been paid overtime. To compute damages, Stefan reviewed the overtime records of employees in this position prior to a job classification change and, in the absence of overtime data after the job classification change, Stefan reviewed sign in and sign out times of the office building.

» For a long-term care provider Stefan used data from timesheets, payroll, and other scheduling records to create comprehensive reports showing potential exposure for each of the claimed areas: timely wage payment, overtime wage payment, adequate daily meal and rest break periods, and travel time compensation.

» For a maternity clothing store chain Stefan performed analyses related to exempt/non-exempt status issues for managers and assistant managers. Stefan also conducted a break time analysis for all employees.

» For a commercial flooring contractor Stefan assessed the job duties and responsibilities of a group of supervisors. During the engagement, the scope of work expanded to include an analysis of misclassification and back-pay exposure for additional groups of employees.

» For a software developer Stefan analyzed how department and project specific characteristics impacted the work flow and the correlation of that impact to certain exemptions.

» For a large meatpacker Stefan conducted a time and motion study to properly assess the duration of certain separately compensated activities to rebut allegations of violation of minimum wage laws.

» For a public university housing department Stefan conducted an extensive time and motion study to identify the tasks (and associated time range to perform each task) related to processing a contract cancellation.

» For a large drugstore chain Stefan used in-store cameras for the smaller stores and actual in-store observations for the larger stores to conduct a time motion study and quantify the time spent by assistant managers on certain pre-defined tasks.

» For a large public storage company Stefan conducted a detailed time and motion study to determine the cost of collection and administration of late payments. Using both self-logging and independent review techniques, Stefan defined each step in the late payment process, calculated the cost to the company for such activities, and compared this cost to the late fees under dispute.

» For a large retail store chain Stefan performed statistical analyses of regularly conducted employee activity surveys.

» For a mass merchandiser, Stefan conducted an observational study of activities of all individuals classified as managers to show significant differences in daily activities.

» For a department store, Stefan conducted an in-store observational study of managers and assistance managers to assess the percentage of time spent on managerial tasks.

» For a state ferry system in the Pacific Northwest, Stefan conducted an observational study of engine room personnel during shift changes to quantify potentially unpaid time worked.

» For a large retail chain Stefan conducted an extensive analysis of the company's compliance with break time rules and regulations and also the employees' usage and potential abuse of break time.

» For a large mass merchandise retailer Stefan compiled a comprehensive database of punch clock data, payroll data, point of sales data, hardcopy information about manual edits of time entries, store security system data, etc. to analyze allegations of inserting breaks, deleting time and forcing employees to work after they clocked out.

» For a large electronic retail chain Stefan analyzed time card data, point of sales data and other store specific attributes to quantify potentially missed meal and rest breaks.

» In a gender discrimination case involving a client in the food processing industry, Stefan analyzed the impact of the implementation of an Affirmative Action Plan on the allegedly discriminatory employment practices.

» In a class action case alleging age discrimination for a vegetable seed company, Stefan performed rebuttal work of the plaintiff's expert's liability and damages analysis.

» In a class action case alleging age discrimination for a major aerospace company, Stefan performed statistical analyses to rebut allegations of age discrimination.

» In a class action race discrimination suit against the Alabama Department of Transportation, Stefan developed statistical regression models and tests to analyze the alleged discrimination.

» In a class action gender discrimination case against a large real estate brokerage firm, Stefan provided deposition testimony to class certification issues.

» In a gender discrimination case against a temporary employment agency, Stefan performed econometric analyses to disprove salary discrimination against two former female employees. Stefan addressed plaintiffs' expert's damages calculations and developed alternative scenarios.

» For a large meat processing plant, Stefan performed statistical analyses of employment data to address allegations of discriminatory hiring practices.

» For a leading publicly-traded developer of enterprise management software, Stefan employed a statistical approach to demonstrate the diversity of investment styles among proposed lead plaintiffs for a securities class action lawsuit alleging section 10b-5 violations and other claims. For the same matter, Stefan employed an econometric approach to estimate potential damages for each lead plaintiff.

» For a leading publicly-traded developer of enterprise management software, Stefan employed an econometric time-series model to analyze allegations of insider trading and the timing of certain stock transactions relative to information available to officers in the company.

» For a shareholder derivative action against a leading publicly-traded health care provider, employed an econometric approach to quantify potential damages per share due to alleged section 10b-5 violations and other claims. For the same matter, developed a multi-trader model to estimate the number of shares potentially damaged.

» For a publicly-traded manufacturer of office supplies, developed a Black-Scholes application and utilized a binomial distribution probability methodology to evaluate the appropriateness of the size of a loan loss reserve related to a loan collateralized by the assets of an employee stock purchase plan.

» For a large software developer, Stefan performed statistical modeling to assist in a securities class action litigation involving allegations of improper revenue recognition, reserve allocations, financial statement disclosures and other accounting irregularities

» For a failed computer hardware company in defense of a 10b-5 securities litigation action, Stefan performed statistical analyses of accounting transactions, inventory and receivable reserves and the auditor's work papers in its evaluation of the allegations.

» In several Rule 10b(5) class actions, Stefan used the event study approach to calculate the value line of a security. In these cases Stefan applied complex and advanced one, two, and multi-trader models.

Survey Sampling

Stefan has extensive experience in designing, conducting, and statistically analyzing surveys. He has applied his expertise in both, the business consulting sector as in litigation proceedings in a wide variety of industries. Stefan's work also often incorporates the review and evaluation of surveys designed, conducted, and analyzed by other consultants and experts. In this capacity Stefan has frequently been asked to assess what can and what cannot be concluded from survey data.

» In a class action alleging misleading advertisement about coupon redemption policies, Stefan analyzed transactional coupon redemption data and conducted a consumer survey about the perceived meaning of the advertising regarding the coupon redemption policies

» In a case involving the meaning of certain endorsement labels on sporting equipment, Stefan analyzed a consumer survey about the recognition and perceived meaning of such labels.

» In a case where a celebrity chef look-alike was used in a commercial, Stefan conducted a survey to assess the extent of consumers' confusion and the potential impact on product sales.

» In a case of advertising slogans for an alcoholic beverage, Stefan conducted a survey to assess whether consumers assumed that the products advertised were from a particular brewery.

» In a post-acquisition study for a large instant breakfast producer, Stefan conducted surveys to assess the value of the acquired brand name and the advantages of keeping that name for certain product lines.

» In a dispute between two golf club manufacturers over advertising claims for their drivers, Stefan performed statistical analyses of test data and a consumer survey to assess the impact of the advertising on the propensity to buy a particular driver.

» For a large consumer products company, Stefan combined statistical modeling of transactional purchase data with consumer surveys to assess the price premiums that consumers were willing to pay for certain national brands over local brands and non-branded products.

» Stefan designed, conducted and implemented consumer surveys about coupon redemption rates, frequency and volume of coupon usage, and the perceived value of coupons in class action settlements.

» Stefan designed and analyzed a survey in a dispute about the perception of customer mis-information concerning the rating process of video and computer games.

» For a large casino operator Stefan designed, conducted, and analyzed surveys about consumer visit frequency and gambling habits to develop a ″comp″ system.

»   Stefan analyzed guest data to analyze the effectiveness of a frequent traveler program as well as group discount pricing. Based on a survey of frequent travelers and utilizing data mining tools Stefan developed predictive models for customer acquisition, retention, and attrition. Stefan also specified share of wallet models. The study resulted in price setting recommendations and a restructuring of the yield management system.

»   Stefan designed a survey of used car dealers to assess the impact of optional equipment and general condition on the value of used automobiles for insurance valuation purposes.

»   In a consumer class action alleging economic losses to the class caused by defective window regulators Stefan designed, conducted, and analyzed a survey used to segment the customer base and identify different levels of economic loss.

»   For one of the largest school districts in the country Stefan designed, conducted and statistically analyzed a survey of school administrators, teaching personnel, students, and parents about the attitude towards a new recycling program prior to its implementation.

»   For a large school district Stefan designed, conducted and statistically analyzed a survey about the acceptance of a recycling program across school administrators, teaching personnel, students, and parents after its implementation. The answers of the survey were cross validated by actually observing and analyzing the recycling behavior on a sample of school yards.

»   In several environmental disputes Stefan designed, conducted and statistically analyzed surveys assessing the willingness to pay among users and non-users of natural resources for cleanup costs related to pollution.

»   In a dispute over alleged underfunding of special education in public schools funding Stefan designed, conducted, and statistically analyzed a survey among school district administrators about allocation of public funds.

»   In a variety of instances for clients across multiple industries Stefan designed, conducted, and statistically analyzed data from customer surveys to assess a qualitative ranking of the importance of goods and services offered and to measure the performance relative to the customers' perception of importance.

»   For the San Diego County Bar Association, Task Force on Diversity in the Profession, Stefan performed a statistical analysis of questionnaires on diversity regarding aspects of race, gender, age, and disability.

»   On numerous occasions Stefan has been retained to critically analyze other experts′ surveys and opine on design, implementation, statistical analysis of data obtained from the surveys, and interpretations and conclusions drawn based on the results.

»   For a large insurance company, Stefan utilized statistical sampling methodology to estimate the potential exposure in a lawsuit alleging the unlawfulness of certain liability waivers in automobile insurance.

»   In numerous wage and hour litigation cases Stefan designed, conducted, and statistically analyzed surveys in junction with observational studies to gain information about how store managers, assistant managers, and/or other salaried employees in supervisory functions allocate their time worked across managerial and non-managerial activities.

   ▪   Including, but not limited to large department stores, electronics retailer, large big box retailer, women's special clothing retailer, women's shoe retailer, sporting goods stores, amusement park industry, restaurant industry, high tech, etc.

»   In numerous wage and hour litigation cases Stefan designed, conducted, and statistically analyzed surveys in junction with observational studies to gain information about the implementation of and compliance of meal and rest break policies.

   ▪   Including, but not limited to large department stores, electronics retailer, large big box retailer, women's special clothing retailer, women's shoe retailer, sporting goods stores, amusement park industry, restaurant industry, high tech, etc.

Non-Litigation

»   For large grocery store chains, Stefan analyzed the effectiveness of a frequent shopper card program utilizing data mining techniques. He also analyzed customer data to facilitate the introduction of one-to-one marketing tools.

»   For a grocery store chain, Stefan utilized econometric elasticity models to recommend pricing strategies for in-store promotions.

»   For a grocery store chain, Stefan developed customer segmentation models to design segment specific marketing campaigns.

»   For the American Film Marketing Association, Stefan performed an economic impact study of the influence of the independent film producers and distributors on the U.S. economy in general, and the California economy in particular.

»   For a large entertainment client, Stefan developed statistical models to predict the return of video cassettes and DVDs.

»   For several clients in the retail industry, Stefan developed statistical models to estimate the liability of unredeemed gift certificates.

»   For a client in the restaurant business, Stefan developed statistical models to quantify the dollar amount of outstanding unredeemed gift certificates.

»   For a major hotel chain, Stefan developed statistical models to forecast the redemption of frequent traveler program points for tax purposes.

» For a high profile e-commerce company, Stefan's team produced an interactive business decision tool to forecast company growth and profitability. The interactive model allows the client, through the choice of a few fundamental inputs, to measure the simultaneous impact on all cost and revenue dimensions of the company, including real estate and equity participation.

» For the Nevada Resort Association, Stefan quantified the economic impact of the gaming industry with special emphasis on the accelerated population growth in greater Las Vegas.

» For the Los Angeles Unified School District, Stefan performed an economic study about the impact of different recycling programs.

» For the Los Angeles County Department of Health Services, Stefan conducted a time and motion study to determine the time required to complete specific Medi-Cal eligibility and provider forms.

» For the Arizona Tax Research Association, Stefan developed economic models to quantify the revenue impact of a proposed change of taxation in the construction sector in Arizona.

» For a hotel property management company, Stefan analyzed customer data, and used data mining methods to develop predictive models for customer acquisition, retention, and attrition.

» For a project analyzing the extent of competition in the market segments of a pipeline company, Stefan estimated regression and Tobit-models to determine optimal bidding behavior for gas storage demand. He prepared testimony given in filings before the Federal Energy Regulatory Commission (FERC).

» For a hotel property management company, Stefan developed a demand driven yield management system.

» For a company providing self-storage space, Stefan developed a demand driven price-setting strategy utilizing own- and cross-price elasticity regression models.

» For a high-tech start-up with a unique service offering of new products, Stefan recommended product-pricing scenarios.

» For a large international conglomerate, Stefan developed customized data mining techniques for the implementation within a customer knowledge management system.

» For a large law firm, Stefan performed a comprehensive statistical analysis of Los Angeles Superior Court jury verdicts over the last decade. The project tested the hypothesis of systematic bias in particular courthouses with respect to plaintiff-win probability, length of trial, length of deliberation, and dollar amounts awarded.

Depositions & Testimony

Depositions

1. MRO Communications, Inc vs. American Telephone and Telegraph Company, United States District Court District of Nevada, Case. No. -5-95-903-PMP, Deposition Testimony, September 26, 1996

2. Yolanda Aiello Harris, individually and on behalf of all others similarly situated; Jennifer Hopkins, individually and on behalf of others similarly situated; Shannon L. Bradley, individually and on behalf of others similarly situated, Plaintiffs, vs. CB Richard Ellis, Inc., a California corporation; CB Commercial INC., a California corporation; Defendants, Superior Court of California, County of San Diego, Case No. GIC 745044, Deposition Testimony, January 5, 2001.

3. State of Tennessee, ex rel., Douglas Sizemore, Petitioner vs. Xantus Healthplan of Tennessee, Inc., Chancery Court of Davidson County, Tennessee at Nashville, Case No 99-917-II, Deposition Testimony, October 11, 2001.

4. Howard Wright, Inc., a California corporation doing business as AppleOne Employment Services, Plaintiffs, vs. Olsen Staffing Services, Inc., a Delaware Corporation, Dagney Smith, an individual, Vicky Riechers, an individual, and Linda Shiftman, an individual, Defendants, Superior Court of the State of California for the County of Los Angeles, Case No. BC 200657, Deposition Testimony, December 7, 2001.

5. Sacred Heart Medical Center, et al., Plaintiffs, -vs- Department of Social and Health Services, and Dennis Braddock, the Secretary of the Department of Social and Health Services, Defendants, Superior Court of the State of Washington in and for the County of Thurston, No. 00-2-01898-1, Deposition Testimony, January 23, 2003.

6. Patrick Bjorkquist individually and on behalf of all others similarly situated, Plaintiff, vs. Farmers Insurance Company of Washington, Defendant, in the Superior Court of the State of Washington for King County, Case No.: 02-2-11684-1 SEA, Deposition Testimony, November 3, 2003.

7. Diversified Property, a general partnership, Dora Saikhon Family Trust, and Nancy Saikhon Borrelli, an individual, Plaintiffs vs. Manufacturers Life Insurance (U.S.A.), a Michigan corporation, erroneously sued as Manufacturers Life Insurance Company, Inc., Defendants in the Superior Court of California, County of San Diego, Case No.: GIC 815128, Deposition Testimony on July 21, 2004.

8. Alan Powers, Plaintiff, vs. Laramar Group et al., Defendants in the United States District Court, Northern District of California, No. C-02-3755 SBA, Deposition Testimony on August 27, 2004.

9. Group Anesthesia Services, A Medical Group, Inc., Claimant, vs. American Medical Partners of North Carolina, Inc., etc., et al., Respondents, JAMS Arbitration, Reference No. 1100040919, Deposition Testimony on February 9, 2005.

10. Group Anesthesia Services, A Medical Group, Inc., Claimant, vs. American Medical Partners of North Carolina, Inc., etc., et al., Respondents, JAMS Arbitration, Reference No. 1100040919, Deposition Testimony on March 11, 2005.

11. Fujitsu v. Cirrus Logic et al., United States District Court, Northern District of California, San Jose Division, Case No. 02CV01627. Deposition Testimony on April 21 and 22, 2005.

12. Goldman et al. v. RadioShack Corporation, United States District Court, Eastern District of Pennsylvania, Case No. 03 CV 0032, Deposition Testimony on May 18, 2005.

13. Perez et al. v. RadioShack Corporation, United States District Court, Northern District of Illinois, Eastern Division, Case No. 02-CV-7884, Deposition Testimony on December 13, 2005.

14. United States of America ex rel. A. Scott Pogue v. American Healthcorp Inc., Diabetes Treatment Centers of America Inc., et al., United States District Court, Middle District of Tennessee at Nashville, Civil No. 3-94-0515, Deposition Testimony on May 12, 2006.

15. School Districts' Alliance v. State of Washington, United States District Court, Eastern District of Thurston, Case No. 04-2-02000-7, Deposition Testimony on July 20, 2006.

16. Boca Raton Community Hospital, Inc., a Florida not-for-profit corporation d/b/a Boca Raton Community Hospital, on behalf of itself and on behalf of Class of all others similarly situated v. Tenet Healthcare Corp., a Nevada Corporation, United States District Court, Southern District of Florida, Miami Division, Case No. 05-80183-CIV-SEITZ/MCALILEY, Deposition Testimony on July 25, 2006.

17. Boca Raton Community Hospital, Inc., a Florida not-for-profit corporation d/b/a Boca Raton Community Hospital, on behalf of itself and on behalf of Class of all others similarly situated v. Tenet Healthcare Corp., a Nevada Corporation, United States District Court, Southern District of Florida, Miami Division, Case No. 05-80183-CIV-SEITZ/MCALILEY, Deposition Testimony on October 13, 2006.

18. Louise Ogborn v. McDonald's Corporation et al., Commonwealth of Kentucky 55th Judicial District, Bullitt County Circuit Court, Case No. 04-CI-00769, Deposition Testimony on October 19, 2006.

19. Elise Davis v. Kohl's Department Stores, Inc. consolidated with Rosie Grindstaff v. Kohl's Department Stores, Inc., Superior Court of the State of California for County of Los Angeles Central District, Case No. BC 327426 (lead case) consolidated with Case No. BC 341954, Deposition Testimony on April 25, 2007.

20. Norman Utley, et al., v. MCI, Inc., MCI Worldcom Communications, Inc., and MCI Network Services, Inc., formerly known as MCI Worldcom Network Services, Inc., United States District Court, Northern District of Texas, Dallas Division, Civil Action No. 3:05 - CV- 0046 - K, Deposition Testimony on May 30, 2007.

21. Ramon Moreno and Ernesto Morailo, on behalf of themselves and all others similarly situated v. Guerrero Mexican Food Products Inc., a division of Gruma Corporation; and Gruma Corporation, a Nevada Corporation, United States District Court, Central District of California, Case No. CV05-773RSWL(PLAx), Deposition Testimony on August 10, 2007.

22. Darensburg et al. v. Metropolitan Transportation Commission, U.S. District Court, Northern District of California, Case No. C-05-1597-EDL, Deposition Testimony on March 18, 2008.

23. In Re: King Pharmaceuticals, INC, Derivative Litigation, Lead Case No: BOO19077(M), The Chancery Court, Sullivan County at Bristol, Tennessee, Deposition Testimony on April 4, 2008.

24. P. Ansley et al. v. Lewis Homes of California, a California General Partnership, et al., Superior Court of the State of California, For the County of Solano, Case No. FCS02445, Deposition Testimony on April 10, 2008.

25. Personnel Plus v. Ashish Wahi et al., Superior Court of the State of California, County of Orange, Case No. 07CC08363, Deposition Testimony on August 13, 2008.

26. First Capitol Consulting Inc. v. LVX, Inc. et al., Superior Court of the State of California for the County of Los Angeles, Case No. BC378202, Deposition Testimony on October 27, 2008.

27. R. Molina et al. v. Lexmark International, Inc., Superior Court of the State of California for the County of Los Angeles, Case No. BC339177, Deposition Testimony on November 19, 2008.

28. In re National Century Financial Enterprises, Inc. Investment Litigation, No. 2:03-MD-1565-JLG-MRA (S.D.Ohio), Deposition Testimony on January 22, 2009.

29. New York City Employees' Retirement System, et al. v. Bank One, N.A., et al., Case No. 03-cv-09973 (LAK) (S.D.N.Y.), Deposition Testimony on January 22, 2009.

30. Dole Fresh Fruit International, Ltd, Hyundai Precision America, Inc., JAMS Arbitration, ADRS Case #05-1138-RTA, Deposition Testimony on December 21, 2009.

31. D. Berry, L. Hedges et al. v. Volkswagen of America, Inc. In The Circuit Court of Jackson County, Missouri, at Independence, No. 0516-CV01171 Division 2, Deposition Testimony on February 18, 2010.

32. D. Aberle et al. v. Davidson Builders, Inc., et al., Superior Court of the State of California, County of Orange, Case No.: 37-2008-00083718-CU-CD-CTL, Deposition Testimony on March 24, 2010.

33. Urga, et al. v. Redlands Community Hospital, Superior Court of the State of California, County of San Bernardino, Case No. SCVSS 123769, Deposition Testimony on May 17, 2010.

34. Oberschlake, et al v. St. Joseph Hospital of Orange, et al, Superior Court of the State of California, County of Orange, Case No. 05CC00301, Deposition Testimony on August 12, 2010.

35. J. Morrison v. The Vons Companies, Inc., Superior Court of State of California, County of San Diego, Case No. 37-2009-00081026-CU-BT-CTL, Deposition Testimony on December 7, 2010

36. R. Pate, et al. v. Children's Hospital of Orange County, Superior Court of California, County of Orange, Case No. 05CC00303, Deposition Testimony on April 13, 2011.

37. M. St. Croix, et al. v. Cedar Fair, L.P., et al., Superior Court of California, County of Orange,   Case No. 30-2008-0214500, Deposition Testimony on August 22, 2011.

38. Steven Domalewski, a minor v. Hillerich and Bradsby Co., et al., Superior Court of New Jersey, Passaic County, Docket No.: PAS-L-2119-08, Deposition Testimony on January 5, 2012.

39. Cathleen McDonough, et al., v. Horizon Blue Cross/Blue Shield of New Jersey, United States District Court, District of New Jersey, Civil Action No. 09-cv-00571-(SRC) (PC), Deposition Testimony on January 10, 2012.

40.   Daniel Ordonez, et al., v. Radio Shack, United States District Court, Central District of California, Case No. CV 10-07060 CAS (JCGx), Deposition Testimony on October 24, 2012.

41.   Ameritox, Ltd., v. Millennium Laboratories, Inc., United States District Court, Middle District of Florida, Case No. 8:11-cv-00775-SCB-TBM, Deposition Testimony on December 20, 2013.

42.   United States of America, ex rel. Glenda Martin v. Life Care Centers of America, Inc., United States District Court Eastern District of Tennessee at Chattanooga, Civ. Action No. 1:08-CV-251, Deposition Testimony on January 15, 2014.

43.   United States of America, ex rel. Tammie Taylor v. Life Care Centers of America, Inc., United States District Court Eastern District of Tennessee at Chattanooga, Civ. Action No. 1:12-CV-64, Deposition Testimony on January 15, 2014.

44.   Darren Smith, et al., v. Panera Bread Company, Superior Court of California, County of San Diego, Case No. 37-201-00084077 CU-BT-CTL, Deposition Testimony on April 30, 2014.

45.   Joseph Hummel et al., v. Castle Principles, LLC et al., Superior Court of California, County of Santa Clara, Case No. 112CV223170, Deposition Testimony on June 19, 2014.

46.   Sherman Way Oil, Inc. (Bijan Pouldar), American Pacific Enterprises Group (Sherwin Louie), Bahman Kohanteb, Hamid Kalhor , Claimants, Vs. Circle K Stores, Inc., Respondent, Alternative Dispute Resolution Case No's 13-7103-DSC through 13-7106-DSC, Deposition Testimony on September 25, 2014.

47.   In re: ExxonMobil Oil Corporation, et al., Southern California Bulk Sale Litigation, Case No. CV12-04689-PA (VBKx), Deposition Testimony on September 25, 2014.

48.   Oracle Wage and Hour Cases, Raghunandam Matam et al., v. Oracle Corporation, Superior Court of California, County of Alameda, No. RG-09480164, Deposition Testimony, October 21, 2014.

49.   G. Taylor et al. v. Shippers Transport Express, Inc., et al., United States District Court, Central District of California, Case No.: CV13-02092-BRO (PLAx), Deposition Testimony on October 24, 2014.

50.   Denise Mays et al. v. Children's Hospital of Los Angeles, Superior Court of California, County of Los Angeles, Case No. BC477830, Deposition Testimony on March 17, 2015.

51.   Direct General Insurance Company v. Indian Harbor Insurance Company et al., United States District Court, Southern District of Florida, Miami Division, Case No. 14-20050-CIV-Cooke/Torres, Deposition Testimony on March 27, 2015.

52.   Dennis Dickman v. Gerdau Reinforcing Steel, et al., Superior Court of California, County of San Bernardino, Case No. CIV-DS-1406231, Deposition Testimony on July 7, 2015.

53.   Fred Devries, et al. v. Morgan Stanley & Co. LLC, et al., United States District Court, Southern District of Florida, Case No. 9:12-cv-81223-KAM, Deposition Testimony on July 31, 2015.

54.   Dennis Dickman v. Gerdau Reinforcing Steel, et al., Superior Court of California, County of San Bernardino, Case No. CIV-DS-1406231, Deposition Testimony on September 11, 2015

55. Leah Davis, and Amy Krajec, et al. v. St. Jude Hospital, Superior Court of California, County of Orange, Case No. 30-2012-00602596-CU-OE-CXC, Deposition Testimony on January 19, 2016.

56. In re MyFord Touch Consumer Litigation, Whalen, et al. vs. Ford Motor Company, United States District Court Northern District of California San Francisco Division, Case No. 13-cv-3072-EMC, Deposition Testimony on February 23, 2016.

57. United States of America, ex rel. Glenda Martin v. Life Care Centers of America, Inc., United States District court Eastern District of Tennessee at Chattanooga, Civ. Action No. 1:08-CV-251 & United States of America, ex rel. Tammie Taylor v. Life Care Centers of America, Inc., United States District court Eastern District of Tennessee at Chattanooga, Civ. Action No. 1:12-CV-64, Deposition Testimony on March 4, 2016.

58. The United States of America and the State of Florida ex rel. Angela Ruckh v. CMC II LLC, United States District court for the Middle District of Florida Tampa Division, Civil Action No. 8:11 CV 1303 SDM-TBM, Deposition Testimony on March 16, 2016.

59. Bertha Sanchez, et al. v. St. Mary Medical Center, et al., Superior Court of the State of California for the County of San Bernardino, Case No. CIVDS 1304898, Deposition Testimony on July 13, 2016.

60. Christian Juarez, et al v. Dignity Health, a California corporation, et al., Superior Court of the State of California, County of Los Angeles, Central Civil West District, Case No. BC550950, Deposition Testimony on August 15, 2016.

61. In Re Dial Complete Marketing and Sales Practices Litigation, United States District Court, District of New Hampshire, Case No. 11-md-2263-SM (MDL Docket No. 2263), Deposition Testimony on August 30, 2016.

62. In Re: Myford Touch Consumer Litigation, United States District Court, Northern District of California, San Francisco Division, Case No. 13-cv-3072-EMC, Deposition Testimony on September 16, 2016.

63. United Healthcare Insurance Company v. Lincare Inc., Case Improvement Plus of Texas Insurance Company: Care Improvement Plus South Central Insurance Company: Care Improvement Plus of Maryland, Inc. v. Lincare Inc., In An Arbitration Before the American Arbitration Association, Case No. 01-15-0003-4095, Deposition Testimony on December 21, 2016.

64. The Moses H. Cone Memorial Hospital Operating Corporation d/b/a Cone Health v. Springfield Service Corporation d/b/a SPI Healthcare, United States District Court for the Middle District of North Carolina, Civil Action No. 1:13-cv-651, Deposition Testimony on January 17, 2017.

65. The People of the State of California, acting by and through Orange County District Attorney Tony Rackauckas v. General Motors LLC, Superior Court of the State of California in and for the County of Orange Complex Litigation Division, Case No. 30-2014-00731038-CU-BT-CX, Deposition Testimony on April 20 and 21, 2017.

66. In Re: Emerson Electric Co. Wet/Dry Vac Marketing And Sales Litigation, United States District Court for the Eastern District of Missouri, MDL No. 2382, Civil Action No. 4:12-md-2382-HEA, Deposition Testimony on May 17, 2017.

67. The People of the State of California, acting by and through Orange County District Attorney Tony Rackauckas v. General Motors LLC, Superior Court of the State of California in and for the County of Orange Complex Litigation Division, Case No. 30-2014-00731038-CU-BT-CX, Rebuttal Deposition Testimony on June 13, 2017.

68. Clayton Dezan, et al. v. Dignity Health, a California Corporation; Community Hospital of San Bernardino, et al, Superior Court of The State of California for the County of San Bernardino, Case No. CIVDS1516658, Deposition Testimony on August 22, 2017.

69. Millennium Health, LLC v. Blue Shield of California, Counterclaim, Blue Shields of California v. Millennium Health, LLC, American Arbitration Association, Case No. 01-15-0005-5926, Deposition Testimony on August 24, 2017.

70. Matthew Townsend, et al. v. Monster Beverage Corporation and Monster Energy Company, United States District Court Central District of California, Case No. 5:12-cv-02188 VAP (KKx), Deposition Testimony on September 20, 2017.

71. Welltower Inc., v. Scott M. Brinker, In the Court of Common Pleas Lucas County, Ohio, Case No. CI-17-2692, Deposition Testimony on October 4th, 2017.

72. In Re Seagate Technology LLC Litigation, United States District Court, Northern District of California San Jose Division, Case No. 5:16-cv00523-RMW, Deposition Testimony on December 12th, 2017.

73. Joanne Hart and Sandra Bueno v. BHH, LLC d/b/a Bell + Howell and Van Hauser LLC, United States District Court for the Southern District of New York, Case No. 1:15-CV-04804-WHP, Deposition Testimony on January 26th, 2017.

74. Thomas Davidson, et al v. Apple Inc., United States District Court Northern District of California San Jose Division, Case No. 5:16-cv-04942-LHK, Deposition Testimony on January 29, 2018.

75. In Re: General Motors, LLC Ignition Switch Litigation, United States District Court Southern District Of New York, Case No. 14-MD-2543 (JMF), Deposition Testimony on February 6th and 7th, 2018.

76. Bertha Sanchez v. St. Mary Medical Hospital, Superior Court of the State of California for the County of San Bernardino, Case No. CIVDS 1304898, Deposition Testimony on March 29, 2018.

77. The State of Texas v. Xerox Corporation, et al., The District Court 53rd Judicial District Travis County, Texas, Cause No. D-1-GV-14-000581, Deposition Testimony on April 12, 2018.

78. Wendy Manemeit, et al. v. Gerber Products Co., The United States District Court for the Eastern District of New York, No. 2:17-cv00093, Deposition Testimony on May 10, 2018.

79. Theodore Broomfield v. Craft Brew Alliance, Inc., United States District Court, Northern District of California, San Jose Division, Case No. 5:17-cv-01027-BLF, Deposition Testimony on June 20, 2018.

80. In RE: General Motors, LLC Ignition Switch Litigation, United States District Court, Southern District of New York, Case No. 14-MD-2543 (JMF), Deposition Testimony on July 5, 2018 and July 6, 2018.

Testimony

1. State of Tennessee, ex rel., Douglas Sizemore, Petitioner vs. Xantus Healthplan of Tennessee, Inc., Chancery Court of Davidson County, Tennessee at Nashville, Case No 99-917-II, Trial Testimony, October 16, 2001.

2. State of Tennessee, ex rel., Douglas Sizemore, Petitioner vs. Xantus Healthplan of Tennessee, Inc., Chancery Court of Davidson County, Tennessee at Nashville, Case No 99-917-II, Rebuttal Testimony, October 26, 2001.

3. Howard Wright, Inc., a California corporation doing business as AppleOne Employment Services, Plaintiffs, vs. Olsen Staffing Services, Inc., a Delaware Corporation, Dagney Smith, an individual, Vicky Riechers, an individual, and Linda Shiftman, an individual, Defendants, Superior Court of the State of California for the County of Los Angeles, Case No. BC 200657, Trial Testimony, March 4, 2002.

4. Columbia/HCA Healthcare Corporation - Billing Practices Litigation, United States District Court, Middle District of Tennessee, Nashville Division, Case No. 3-98-MDL-1227 on June 28, 2002.

5. Sacred Heart Medical Center, et al., Plaintiffs v. Department of Social and Health Services, and Dennis Braddock, the Secretary of the Department of Social and Health Services, Defendants, Superior Court of the State of Washington in and for the County of Thurston, No. 00-2-01898-1, Testimony in Liability Trial, April 14, 2003.

6. Diversified Property, a general partnership, Dora Saikhon Family Trust, and Nancy Saikhon Borrelli, an individual, Plaintiffs v. Manufacturers Life Insurance (U.S.A.), a Michigan corporation, erroneously sued as Manufacturers Life Insurance Company, Inc., Defendants in the Superior Court of California, County of San Diego, Case No.: GIC 815128, Trial Testimony on October 25, 2004.

7. Bridgestone/Firestone North American Tire v. Sompo Japan Ins. Co. of America, United States District Court for the Middle District of Tennessee Nashville Division Civil Action NO. 3-02-1117, March 7, 2005

8. Group Anesthesia Services, A Medical Group, Inc., Claimant, vs. American Medical Partners of North Carolina, Inc., etc., et al., Respondents, JAMS Arbitration, Reference No. 1100040919, Arbitration Testimony on March 23, 2005.

9. Goldman et al. v. RadioShack Corporation, United States District Court, Eastern District of Pennsylvania, Case No. 03 CV 0032, Testimony in Liability Trial, on June 28 and 29, 2005.

10. Goldman et al. v. RadioShack Corporation, United States District Court, Eastern District of Pennsylvania, Case No. 03 CV 0032, Rebuttal Testimony in Liability Trial, on July 5, 2005.

11. Mauna Loa Vacation Ownership LLP v. Accelerated Assets, LLP. United States District Court, District of Arizona, Case No. CIV 03-0846 PCT DGC. Trial Testimony, on February 22, 2006.

12. School Districts' Alliance v. State of Washington, United States District Court, Eastern District of Thurston, Case No. 04-2-02000-7, Trial Testimony on November 13, 2006.

13. In the Matter of Premier Medical Group, PC, Appellant – Department of Health and Human Services, Office of Medicare Hearings and Appeals, Southern Field Office, ALJ Appeal No. 1-221579701, Medicare Appeal No. 1-18761858, Provider No. 3706654, AR No. 9406352171039, Judge Zaring Robertson, US Administrative Law Judge, Testimony on April 1, 2008.

14. Darensburg et al. v. Metropolitan Transportation Commission, U.S. District Court, Northern District of California, Case No. C-05-1597-EDL, Trial Testimony on October 9, 2008.

15. R. Molina et al. v. Lexmark International, Inc., Superior Court of the State of California for the County of Los Angeles, Case No. BC339177, Trial Testimony on October 22 and 26, 2009.

16. Dole Fresh Fruit International, Ltd, Hyundai Precision America, Inc., ADRS Case #05-1138-RTA, Trial Testimony on February 19, 2010.

17. In the matter of University of Tennessee Cancer Institute, ALJ Appeal No. 1-446 575 318, Office of Medicare Hearings & Appeals, Judge Z. Robertson, US Administrative Law Judge, Testimony on April 20, 2010.

18. Urga, et al. v. Redlands Community Hospital, Superior Court of the State of California, County of San Bernardino, Case No. SCVSS 123769, Trial Testimony on July 20, 2010.

19. Marine Engineers' Beneficial Association v. Department of Transportation, Ferries Division Federal Mediation & Conciliation Service Cause No. 110105-52404-6 AGO Matter No. 10499471, July 19, 2011.

20. Richard Robinson v. County of Los Angeles, et. al., United States District Court of California, Central District, Case No. CV06-2409 GAF (VBKx), Trial Testimony on December 1, 2011.

21. In the matter of American Home Patient, ALJ Hearing, Appeal No. 1-982137828, Office of Medicare Hearings & Appeals, Miami Office Southern Field Division, Testimony on October 29, 2012.

22. In the matter of American Home Patient, ALJ Hearing, Appeal No. 1-924297238, Office of Medicare Hearings & Appeals, Irvine Office Western Field Division, Hearing Testimony on February 28, 2013.

23. TaylorMade Golf Company Challenge to Callaway Golf Company's Final Response, National Advertising Division, New York, Testimony on March 13, 2013.

24. United States of America, ex rel. Tammie Taylor v. Life Care Centers of America, Inc., United States District Court Eastern District of Tennessee at Chattanooga, Civ. Action No. 1:12-CV-64, Testimony on May 13, 2014.

25. United States of America v. Houshang Pavehzadeh, United States District Court for the Central District of California, No. CR 13-0320-R, Testimony on May 19, 2014.

26. Sherman Way Oil, Inc. (Bijan Pouldar), American Pacific Enterprises Group (Sherwin Louie), Bahman Kohanteb, Hamid Kalhor , Claimants, Vs. Circle K Stores, Inc., Respondent, Alternative Dispute Resolution Case No's 13-7103-DSC through 13-7106-DSC, Arbitration Testimony on October 10, 2014.

27. Heidi's Children Dental Center (DC14-0813-204-LM) vs. Denti-Cal, Testimony at Administrative Law Judge Hearing, Judge Lewis Munoz, in Los Angeles on November 5, 2014.

28. AdvanceMed Audit of Altercare of Wadsworth, Medicare Appeal, Medicare Appeal No. 1-912446681, Testimony in Administrative Law Judge Hearing on February 19, 2015.

29. Michael Bozsik v. Livingston International Inc., Ontario Superior Court of Justice, Court File No. 5270/14, Cross Examination Testimony on May 12, 2016.

30. Bertha Sanchez, et al. v. St. Mary Medical Center, et al., Superior Court of the State of California for the County of San Bernardino, Case No. CIVDS 1304898, Certification Hearing Testimony on October 21, 2016.

31. In Re Dial complete Marketing and Sales Practice Litigation, United States District Court, District of New Hampshire, Case No. 11-md-2263-SM (MDL Docket No. 2263), Hearing Testimony on November 16, 2016.

32. United Healthcare Insurance Company v. Lincare Inc., Case Improvement Plus of Texas Insurance Company: Care Improvement Plus South Central Insurance Company: Care Improvement Plus of Maryland, Inc. v. Lincare Inc., In An Arbitration Before the American Arbitration Association, Case No. 01-15-0003-4095, Arbitration Testimony on February 6, 2017.

33. The United States of America and The State of Florida ex rel. Angela Ruckh v. CMC II, LLC, United States District Court for the Middle District of Florida Tampa Division, Civil Action No. 8:11 CV 1303 SDM-TBM, Trial Testimony on February 8, 2017.

34. Federal Government of Germany v. A Consortium of Publicly Traded Companies in an arbitration under the laws of Germany, Arbitration Testimony on March 21 and 22, 2017.

35. In Re Determination of Royalty Rates and Terms for Transmission of Sound Recordings by Satellite Radio and "Preexisting" Subscription Services (SDARS III), United States Copyright Royalty Judges The Library of Congress Washington, D.C., Docket No. 16-CRB-0001-SR/PSSR (2018-2022), Trial Testimony on May 9, 2017.

36. ZPIC Audit Appeal of Providence Health System Southern California, Office of Medicare Hearings and Appeals, OMHA Appeal Number 1-1823418684, Hearing Testimony on October 16, 2017.

37. New Beacon Healthcare Group, LLC, Medicare Appeal Number 1-1269788965, Hearing Testimony on December 1, 2017.

38. OMHA Statistical Sampling Program, Arriva Medical, LLC, ALJ appeal No. 1-1874414073, Hearing Testimony on March 23, 2018.

39. Christopher Corbin, et al. v. Indus Investment, Inc., Superior Court of the State of California for the County of Los Angeles, Case No. BC565881, Trial testimony on April 6, 2018.

40. Toll Collect GmbH v. Federal Republic of Germany, Hearing Testimony on April 16, 2018.

41. Arriva Medical, LLC, ALJ Appeal No: 1-1945149644 (Sub-Universe August 2013), Appellant's Hearing Testimony on April 18, 2018.

Speaking Engagements

1. Washington Health Care Conference, May 2016.

2. 4th Advanced Forum on False Claims & Qui Tam Enforcement Conference, January 2017.

3. False Claims Act/Qui Tam Whistleblowers Litigation: Hot Buttons in 2017 Live Webcast, March 2017.

4. Fraud & Abuse: Part II – Understanding Statistical Sampling, Live Webcast, September 2017.

5. American Hospital Association Chief Compliance Officers Roundtable: Defending against audits using statistical sampling and extrapolation, April 2018.

Publications

Boedeker, Stefan and Goetz Trenkler (2001) - "A Comparison of the Ridge and Iteration Estimator" - in: Econometric Studies: A Festschrift in Honour of Joachim Frohn (ed. by Ralph Friedmann, Lothar Knueppel, and Helmut Luetkepohl), New Brunswick

Professional and Business History

» Berkeley Research Group, 2010 - Present, Managing Director

» Resolution Economics, 2008 - 2010, Partner

» Alvarez & Marsal, 2007 - 2008, Managing Director

» LECG LLC, 2005 - 2007, Director

» Navigant Consulting Inc., 2004 -2005, Managing Director in Litigation and Investigation Practice

» Deloitte & Touche LLP, 2003 - 2004, Leader of the Economic and Statistical Consulting Practice in the West Region

» PricewaterhouseCoopers LLP, 2002 - 2003, Leader of the Litigation Consulting Group in Los Angeles, Leader of the Economic and Statistical Consulting Practice in the West Region

» Andersen LLP, 1992 - 2002, Partner (since 2000), last position held: Director of Economic and Statistical Consulting practice in the Pacific Region

» University of California, San Diego, 1989 - 1991, Teaching Assistant, Department of Economics

» German Government, 1986 - 1989, Economic Research Assistant